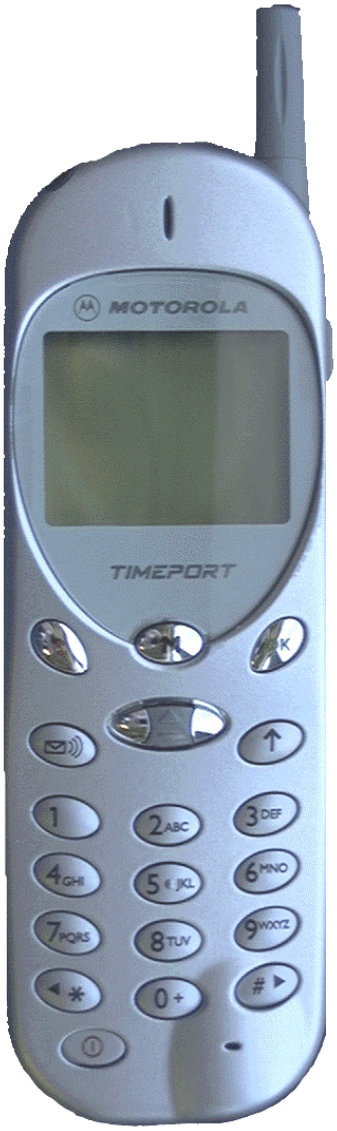
MOTOROLA

Personal Communications Sector

P7689 / P7789

GSM Service Support

Training - Documentation - Engineering



Level 1 & 2 Service Manual

Rev 1.4

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SECTION 1: GENERAL

1.1 Introduction

This manual is intended for use by technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Although there is a **P7689 Flat** and a **P7789 Flipped** version of this unit we shall just refer to one model from now on, the P7689.

The scope of this document is to provide the reader with basic information relating to the P7689, and also to provide procedures and processes for repairing the units up to and including Level 2 repair.

Level 1 and 2 repairs involve the following activities to be carried out: -

- Unit swap out
- Repairing of mechanical faults
- Basic modular troubleshooting
- Testing and verification of unit functionality
- Upgrading software
- Flexing units
- Initiate warranty claims and send faulty modules to Level 3 or 4 repair centres.

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1.2 Motorola Service Policy for P7689 in warranty

1.2.1 Warranty:

Product will be sold with the standard 12 months warranty terms and conditions. Accidental damage misuse, retailers extended warranties will not be supported under warranty. Non warranty repairs will be available at agreed fixed repair prices.
Proof of purchase will be required to validate warranty claims.

1.2.2 Out of Box Failure Policy

The standard OOB failure criteria will apply. Customer units that fail very early on, after date of sale, are to be returned to Manufacturing for root cause analysis, to guard against epidemic criteria. Manufacturing to bear the costs of early life failure.

1.2.3 Product Support

Customers original units will be repaired but not refurbished as standard. Appointed Motorola Service Hubs will perform warranty and non-warranty field service for level 2 (assemblies) and level 3 (limited PCB component). The Motorola HTC centres will perform level 4 (full component) repairs.

1.2.4 Customer Support:

This will be available through dedicated Call Centres and In Country Help Desks.
Product Service training should be arranged through the local Motorola Support Centre.

1.2.5 Replacement Parts Ordering

Only centres authorized to carry out repairs will be able to purchase spare parts. Orders for spare parts from Hub’s and Hi-Tech Centres should be placed with the regional Motorola Parts Distribution Centre.

1.3 General Safety Information

1.3.1 Portable Operation

- DO NOT hold the radio so that the antenna is very close to, or touching, exposed parts of the body, especially the face or eyes whilst transmitting. The radio will perform best if it is held in the same manner as you would hold a 'land' telephone handset, with the antenna angled up and over your shoulder.

- DO NOT operate the portable phone in an aircraft. Switch off your telephone. The use of a cellular telephone in an aircraft may be dangerous to the operation of the aircraft, disruption of the Cellular Network may occur, and is illegal. Failure to observe this instruction may lead to a suspension or denial of Cellular Telephone Service to the offender, or legal action, or both.

1.3.2 Mobile/Portable Operation - Telephone use in Vehicles:

- All equipment must be properly grounded according to installation instructions for safe operation.

- Users are advised to turn off their equipment when at a refueling point.

- Safety is every driver's responsibility. Cellular telephones should only be used in situations in which the driver considers it safe to do so.

1.3.3 General

- DO NOT allow children to play with any radio equipment containing a transmitter.

- DO NOT operate this equipment near electrical blasting caps or in an explosive atmosphere. Mobile Telephones are, under certain conditions, capable of interfering with blasting operations. When you are in the vicinity of such work, look out for and observe signs cautioning against mobile radio transmission. If transmission is prohibited, you must turn off your mobile telephone to prevent any transmission.
  In standby mode the mobile telephone will automatically transmit to acknowledge a call if it is not turned off.

- Refer to the appropriate section of the product user manual for additional pertinent safety information

- All equipment should be serviced only by a Motorola qualified technician.

SECTION 2:
P7689
DESCRIPTION

2.1 Specifications of P7689

General

Function	**Specification**
Frequency Range GSM Frequency Range DCS Frequency Range PCS	880-915 MHz TX (with EGSM) 925-960 MHz RX 1710-1785 MHz Tx 1805-1880 MHz Rx 1850.2 – 1909.8 MHz Tx 1930.2 – 1989.8 MHz Rx
Channel Spacing	200 kHz
Channels	174 GSM/374 DCS carriers with 8 channels per carrier
Modulation	GMSK at BT = 0.3
Transmitter Phase Accuracy	5 Degrees RMS, 20 Degrees peak
Duplex Spacing	45 MHz GSM 95MHz DCS 80MHz PCS
Frequency Stability	± 0.10 ppm of the downlink frequency (Rx)
Operating Voltage	Full Rate PSU = 4.4V +/- 5% (During Charging = VBatt +/-5% 6.63V Mid Rate Charger = 5.9V +/- 0.3V CLA Supply = 4.4V Battery Operating Voltage = 2.85V(Radio Shut Down voltage) To 4.2V Max
Transmit Current	Typically 250 ma avg, 1.0A peak
Stand-by Current	Typically 7.0 ma (DRX2)
Dimensions	130mm x 46mm x 23 mm (max. Thk.)
Size (Volume)	97 cc with Dao 550 mAh LiO Battery
Weight	102.9g with Dao 550 mAh LiO Battery
Temperature Range	-10C to +55C

Transmitter

Function	***Specification***
RF Power Output	33 dBm ± 2dB GSM/ 30 dBm ± 2 dB DCS
Output Impedance	50 ohms (nominal)
Spurious Emissions	-36 dBm from 0.1 to 1 Ghz -30 dBm from 1 to 4 Ghz

Receiver

Function	***Specification***
RF Level	-102 dBm
RX bit error rate (100 k bits)	< 2%
Channel Hop Time	500 microseconds
Time to Camp	Approximately 5-10 seconds

Speech Coding

Function	***Specification***
Speech Coding Type	Regular Pulse Excitation / Linear Predictive Coding with Long Term Prediction. (RPE LPC with LTP).
Bit Rate	13.0 k bps
Frame Duration	20 ms
Block Length	260 bits
Classes	Class 1 bits = 182 bits. Class 2 bits = 78 bits
Bit Rate with FEC Encoding	22.8 k bps

2.2 P7689 Overview

The P7689 is of the Tri Band technology range allowing roaming using the GSM 900 / 1800 / 1900 bands. (see below) The unit is a follow on but will not replace the L7389 / L7489. As will be seen, the form factor for the P7689 is very different to P7389 or V2088. The unit will still be marketed within the Timeport brand, aimed at the organised business users. The following are a few of the main selling features that will be included with the unit.

- Using the Whitecap lower voltage technology this offers good standby and talk times(see below)
- Extended GSM channels
- Tri-Codec allowing Full Rate / Half Rate / Enhanced Full Rate modes of transmission.
- SIM Toolkit.(STK 2.4)
- Enhanced Infrared Data link (see below)
- 3 Pin RS232 connection.
- PIM _ Personal Information Manager – basic diary function
- 96 x **64** row full graphics TMF film (for enhanced contrast) with contrast control. (larger display that P7389)
- Internal Headset
- Speaker Dependant Voice recognition (see below)
- Vibracall^{TM}
- Voicenotes^{TM} Alarmed with selective erase – 2 minutes
- WAP 1.1. compliant
- Datebook
- Answering Machine
- Silent Answer
- Calling Name Presentation
- Display Animation
- Scheduled Call Divert
- Concatenated SMS
- Smart Card support – E- Commerce
- Blue Backlights
- Chromed Keypad for OK and C Keys, chrome rocker MENU key and all other keys, film type with transparent numbering.
- New Ringer Tones
- Programmable Ringer Tones
- Enhanced Chinese Key entry
- New Games – (see below)

IrDA – Infra red Data Association, This feature will allow the user to link their mobile phone to their computer terminal. This will allow the user to upload and download information, such as phonebok information, SMS messages, FAX data etc… without the requirement for cables. The unit can also communicate with other IrDA devices such as pagers and other mobile phones.
Perfect alignment of the beam is not required due to the spread of the beam.
IP SMS allows SMS messages to be constucted on a PC then downloaded to the P7689 to be transmtted.
IP Phonebook allows very easy and extremely flexible download / upload of phonebook information, enabling select phonebooks available to each user, which can be quickly changed for example when travelling to different areas.
The last 10 calls made and received can also be downloaded allowing databases to be created.
The P7689 can be placed into IrDA mode via either the quick access menu or through the Phone Set up menu structure ‘ Activated’ will appear on the screen once the feature has been selected followed by ‘Connection Made’ once transfer of data is available between the P7689 and the other device. The P7689 software allows more devices to be synchronised with phone e.g.Win NT, Psion and Palm.

Speaker Dependant Voice Recognition – This feature allows 'Voice Tags' to be allocated to upto 25 names within the users phone memory and also upto 15 Voice tags be allocated to the quick access functions. The unit must be 'trained' for this function (ie the voice tags must first be read into the phones memory twice before recognition can be made.)
Two main points whilst using this option.

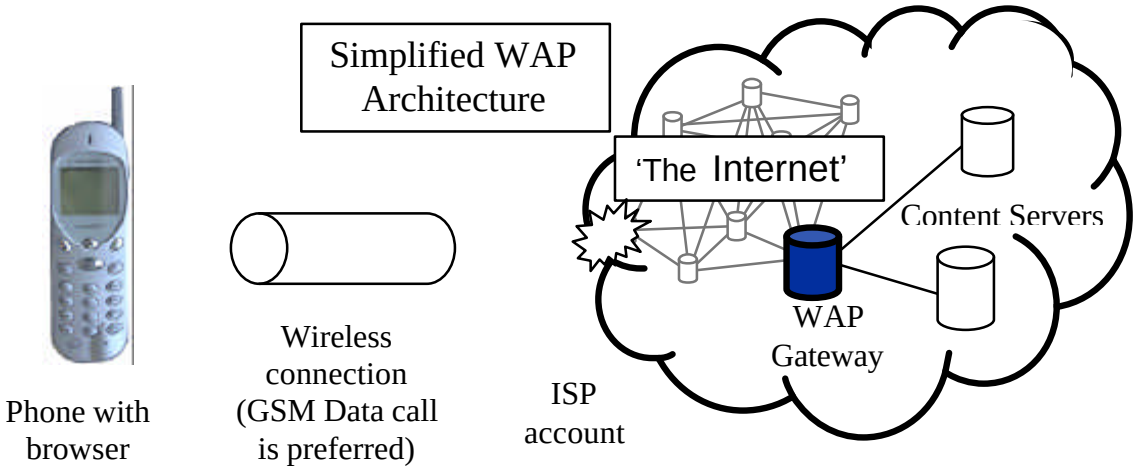
*THERE WILL BE NO SERVICE DURING 'TRAINING' WHICH MEANS THE USER CANNOT RECEIVE OR MAKE CALLS DURING THIS TIME.
*THE VOICE TAGS CAN ONLY BE ADDED TO THE PHONES MEMORY, AS GSM DOES NOT ALLOW THE OPTION TO STORE VOICE TAGS ONTO THE SIM CARD.
Voice tags can be added to the phones memory using the usual name addition methods ie via the phonebook menu structure, using the M+ key, or using the quick access keys.

To make a call to a person allocated with a voice tag, the smart button must first be pressed, then the P7689 will ask for a name, if the name is recognised, then the name will be repeated and displayed on the screen. A call can then be placed.
For access to one of the quick access functions the quick access key must first be pressed, a name will then be asked for, if the name is recognised e.g. Battery Meter then the name will be repeated and the corresponding feature e.g. the battery meter will be displayed on the screen.
If 2 names are too alike then the unit will request another name.

CUG (Closed User Group) This is a network application which allows a select group of users only to use a particular group of mobile units e.g. In the circumstance where a manager of a field service team only wants the team to be able to call other users within his team (or CUG).

Phase 2 USSD (Unstructured Supplementary Services Data) – This is an application whereby pressing a certain key or combination of keys whilst in idle mode ie not in a call can access certain network functions such as helplines etc...

- **WAP 1.1 Compliancy (Wireless Application Protocol) - WAP 1.1** Wireless Application Protocol



- In the WAP environment this is how the access is made.

1. The request for information is made in WML (Wireless Markup Language) derived from HTML.
2. Request is passed to WAP Gateway, which retrieves the information from the server in standard HTML (which is then filtered to WML) or if available WML format.
3. The information is then passed the cellular user, via the cellular network provider.

- There will be 5 Data parameters that the user will be able to edit:
  -Baud rate - between 2400 and 14400

-Idle time out
-Line type
-Phone Number
-Connection type

- For image download, the bitmap image will be downloaded as text and if the image is larger than the screen then only part of the image will be displayed

- Ways to access Browser - Quick access key and Feature Menu

During browser mode, if incoming call is received then the browser will be paused with the user having the option to resume after the call.

Simplified Alpha Text Entry - This gives the allowance to use all forms of Roman and Chinese Key entry on a 96 X 54 display.
At present only Latin based characters can be entered using the multi tap key entry.

There are 3 forms of CKE (Chinese Key Entry):

- Pin Yin - Simplified Chinese (Mainland China)
- Bo-po-mo-pho - Complex Chinese (Taiwan)
- Stroke based method for both Simple and Complex
- Can be used with phone book and SMS features
- European and Pan American models will be able to switch between Roman and Latin Key Entry
- Asian Models will be able to switch between all Key entries.

Calling Name Presentation - This is an improvement on the existing name presentation.

- At present name from phone book is displayed by comparing last 8 digits of Number
- New feature will show name as sent by the network. This is up to 80 characters, but will be shortened to 12 for the phonebook.
- This functionality must be subscribed to with network.
- Caller can restrict this
- On call arrival phone Number is compared to phonebook if match is found but name is not allocated then callers name will be stored.(However if there is any text against that number it will not be overwritten)

Display Animation - Aimed at physically showing the customer is executing commands.
Existing animations are for Power up and Down sequences.

- New animations -
- Incoming / sending call
- Incoming / sending SMS
- IrDA Quick Access icon

Call Divert Interrogation - This function is just a more accurate way of ensuring that the caller is diverted to the correct number, this is mainly achieved through the co-operation of the network providers.

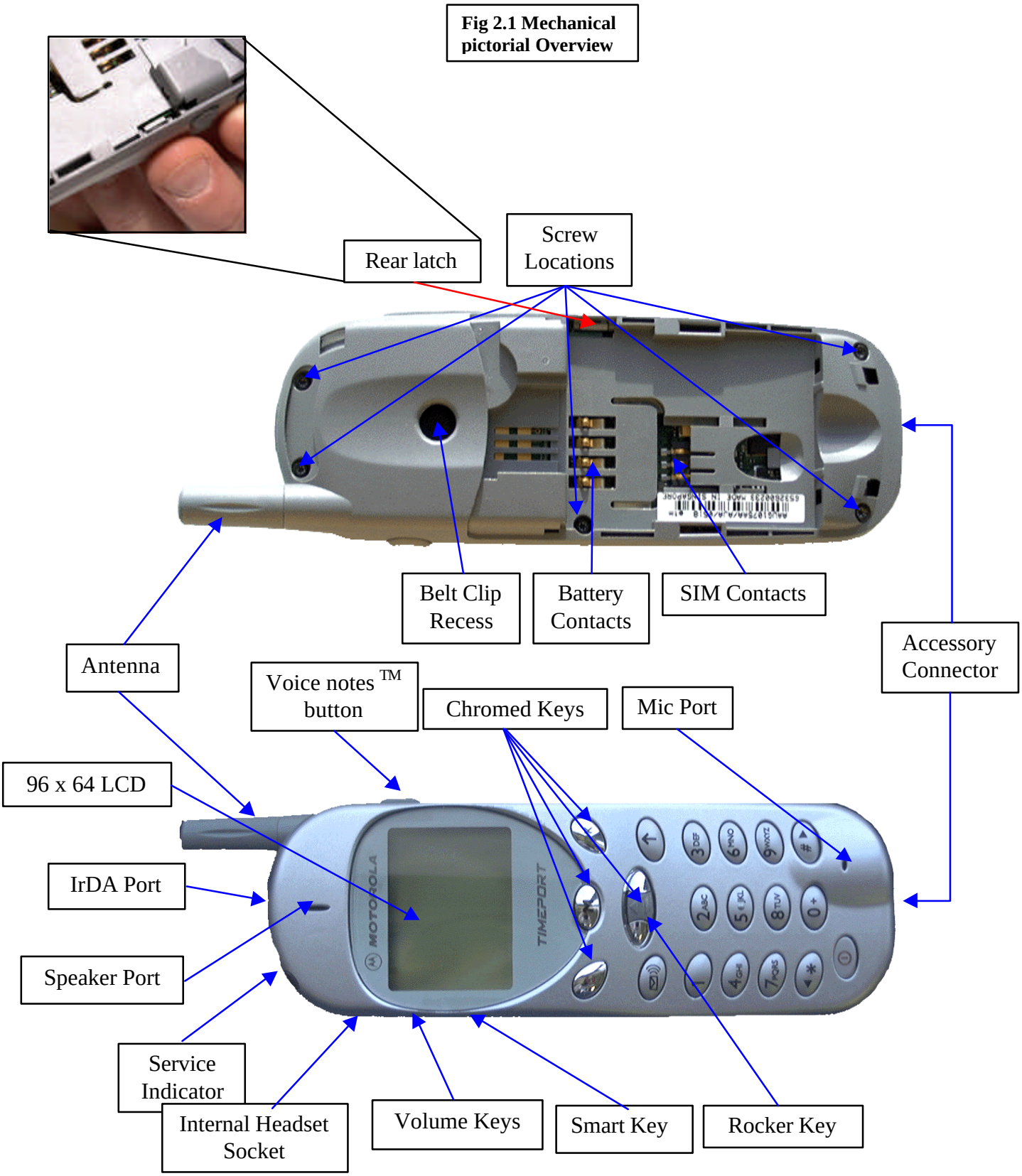
Concatenated SMS - Concatenated: A series of linked events
Increases the amount of characters that can be sent and received from the phone.
Currently can send 1 SMS of 160 characters and the SIM can store 10 of these.
New functionality will support 5 X 153 Character messages and the SIM will be able to hold between 30 and 75 slots dependant on type of card and memory already allocated, each slot will hold 160 characters.

Connectivity – The P7689 will support the Communicate soft Modem via the RS232 cable
56K global Modem and AT Command parsing via IrDA.

Games – There will be 3 games supported, these being :

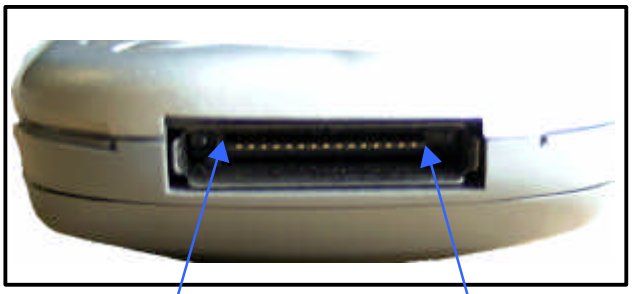
- Brick
- Baccarat
- Tower of Hanoi

Fig 2.1 Mechanical pictorial Overview



There will be 4 colours of front housing – Metallic Silver / Metallic Titanium / Metallic Graphite / Metallic Aluminium.

2.3 Connector Pinouts



Charger Socket Pin Layout

1.GND	2.SW_RF
3.GND	4.BATT_FDBK
5.MAN_TEST_AD	6.RS232_TX
7.RS232_RX	8.CHG_EN
9.ON_2*	10.GND
11.DSC_IN*	12.DOWNLINK
13.DSC_EN	EXT B+
15.GND	

2.4 Talk Times, Weight and Volume Matrix

Volume (cc)	Weight (g)	Talk Time (min)*	Standby Time (hours)*	with Battery
97 cc	102.6 g	120-180	40-130	550 mAh LiIon
102 cc	106.2 g	120-210	45-150	Slim LSQ6 600mAh Li Ion
113 cc	129.5 g	210-330	70-240	LSQ8 900 mAh Li Ion

All battery performance times are approximate and will vary depending on network configuration, band and status, and the functions selected. Times are quoted as a range from DRX=2 to DRX=9. Support of DTX mode is dependent on network support and may not be available in all areas.

2.5 Battery Charging Times

Identical to Leap, maximum charge times shown.

Battery	Leap Mid Rate Travel Charger to 90% charge (LiIon only)
LSQ6 600 mAh LiIon	120 min
LSQ8 900 mAh LiIon	230 min
Dao 550 mAh LiIon	110 min

2.6 Battery Technology

Battery technology will use the 3.6 V platform and use label-wrapped batteries. Jade will also employ battery safety that will not allow the phone to charge a non-Motorola battery.

The P7689 will allow battery charging via mid rate charger or EP charger via the Hirose connector.

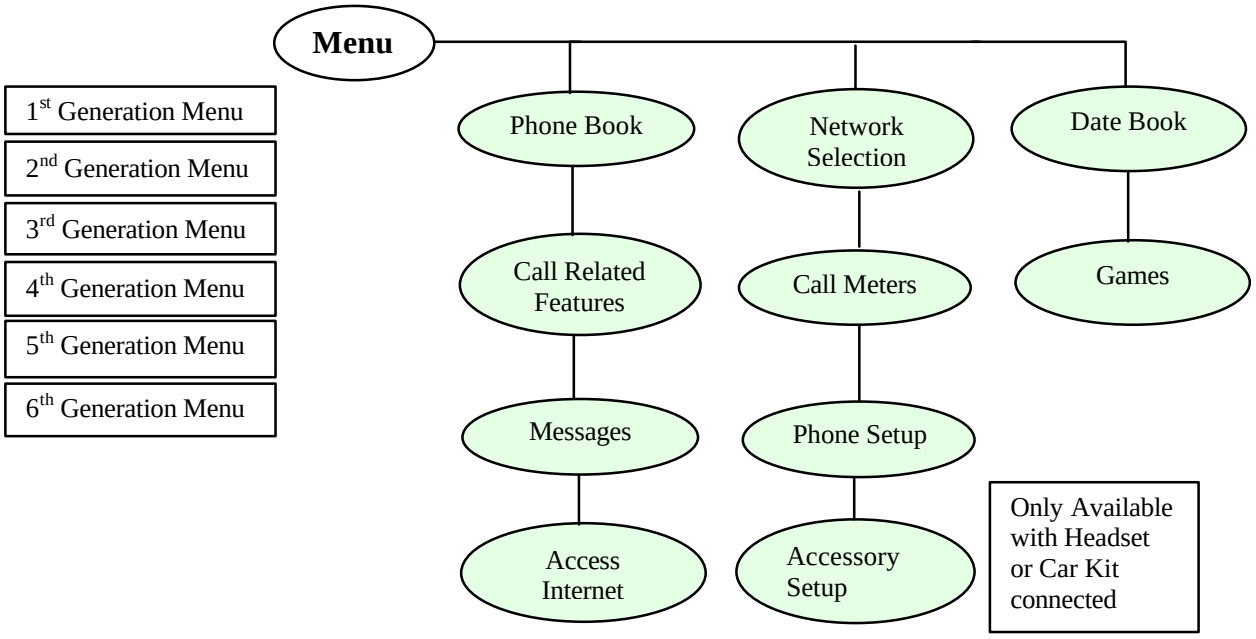
2.7 Physical Dimensions

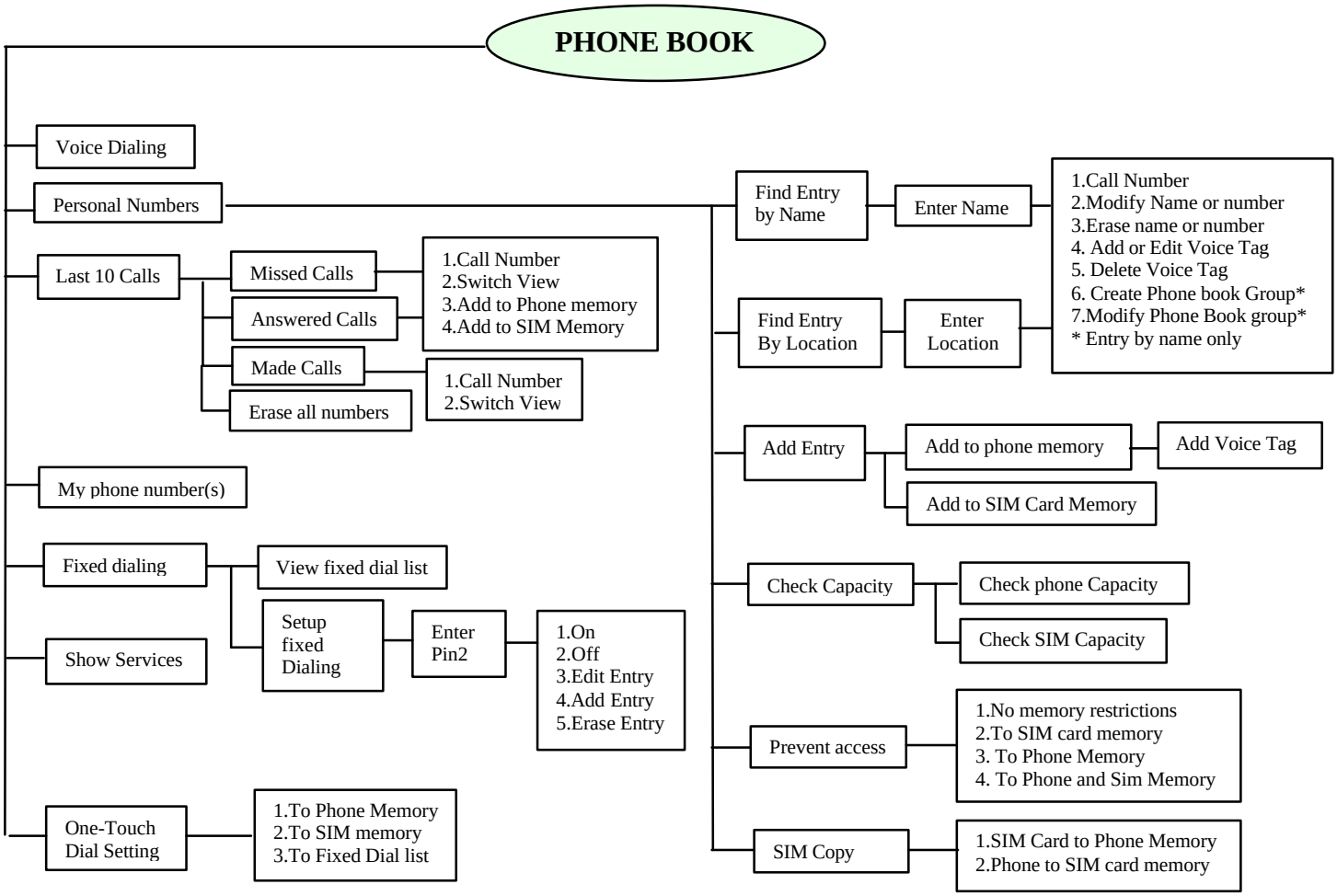
Dimensions		P7789	P7689
Length		130 mm	130 mm
Width		46 mm	46 mm
Extra slim battery door With Slim LiIon battery (550 mAH)	Depth	25 mm	23 mm
	Volume	108 cc	97 cc
	Weight	107 g	102.9 g
Slim battery door With LSQ6 (600 mAH LiIon)	Depth	26 mm	24 mm
	Volume	112 cc	102 cc
	Weight	110 g	106.2 g
Thick battery door With LSQ8 (900 mAH LiIon)	Depth	27 mm	26 mm
	Volume	124 cc	113 cc
	Weight	130 g	129.5 g

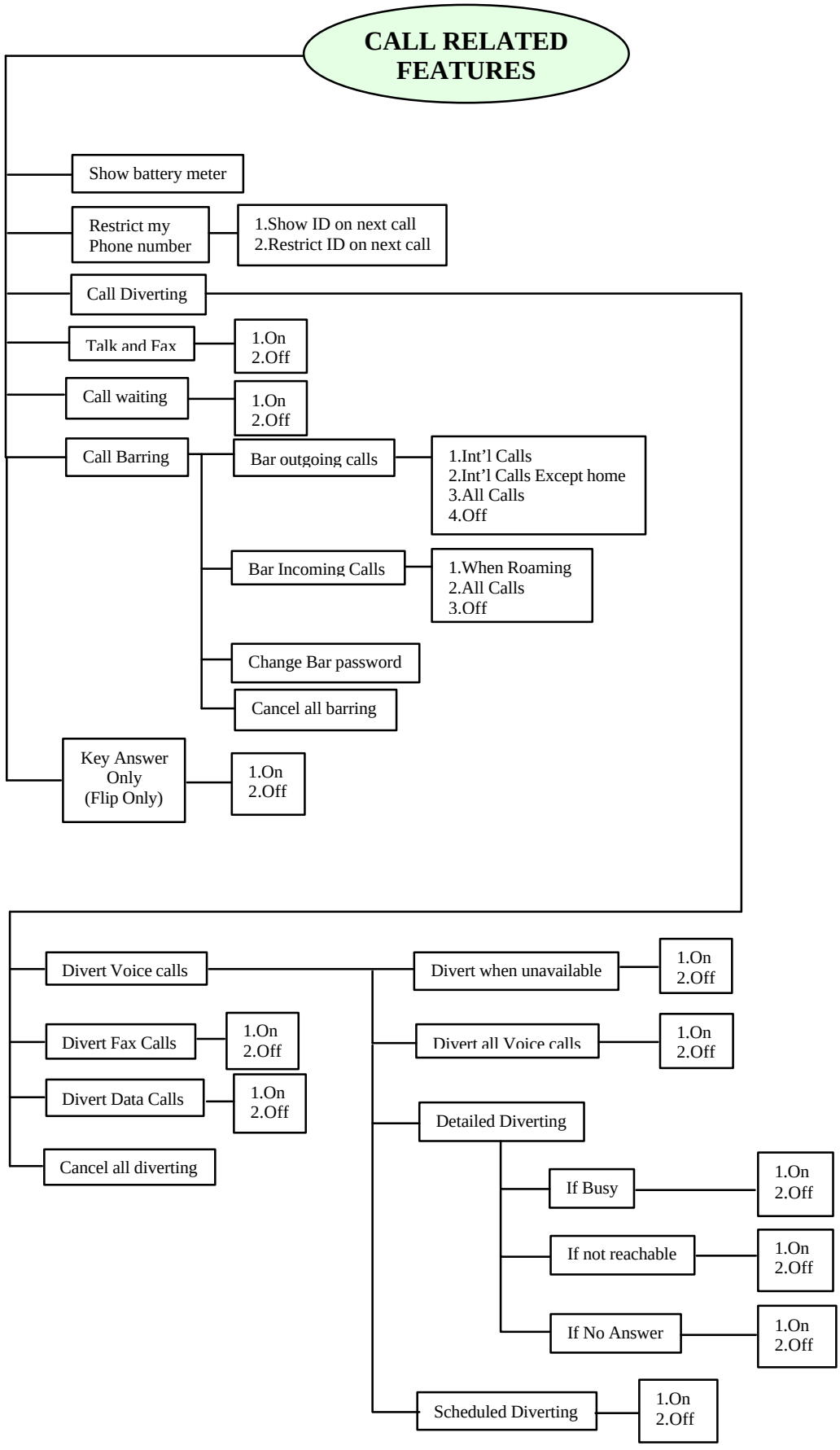
SECTION 3: FEATURE LIST

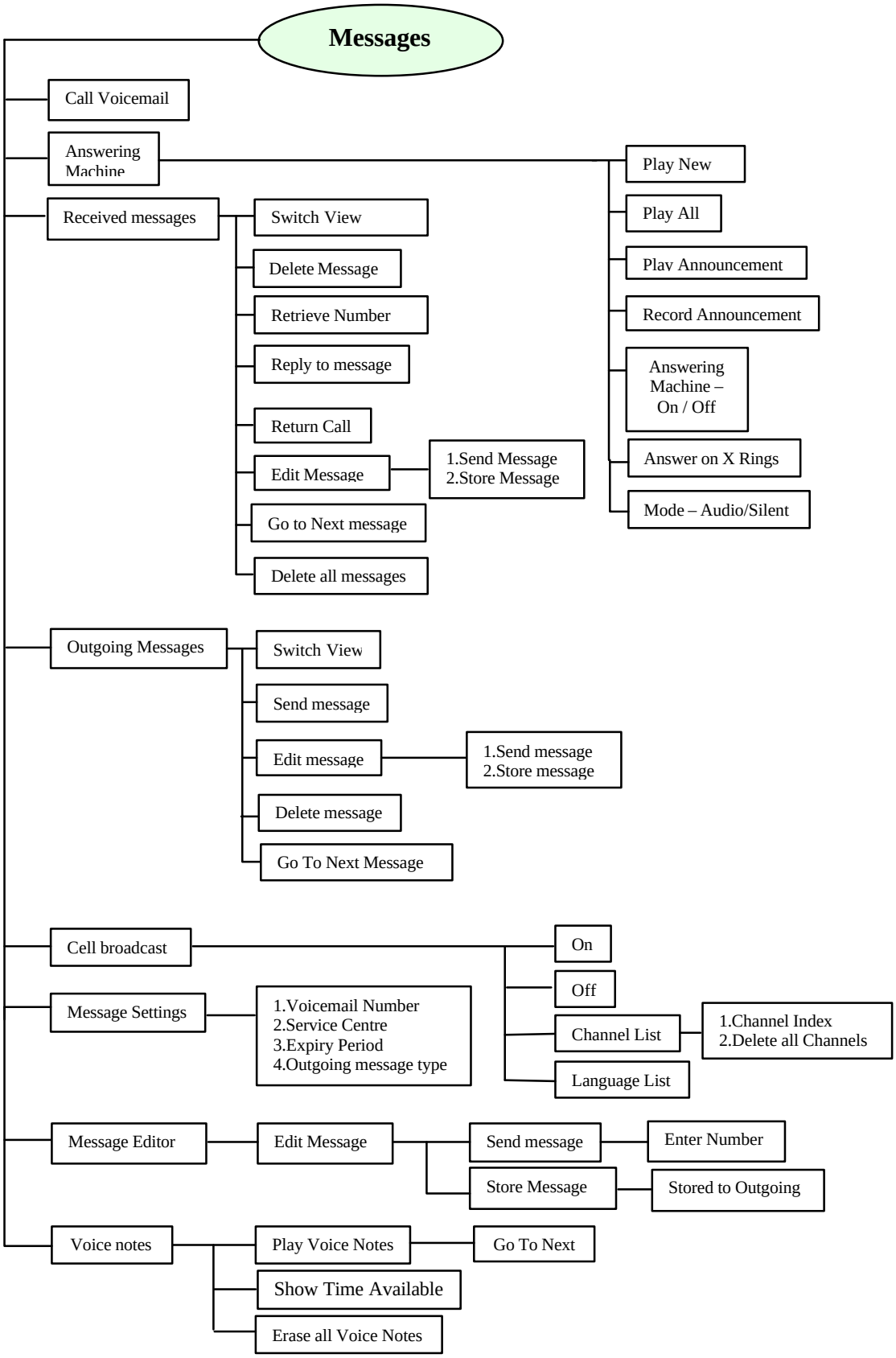
3.1 List of Features Available

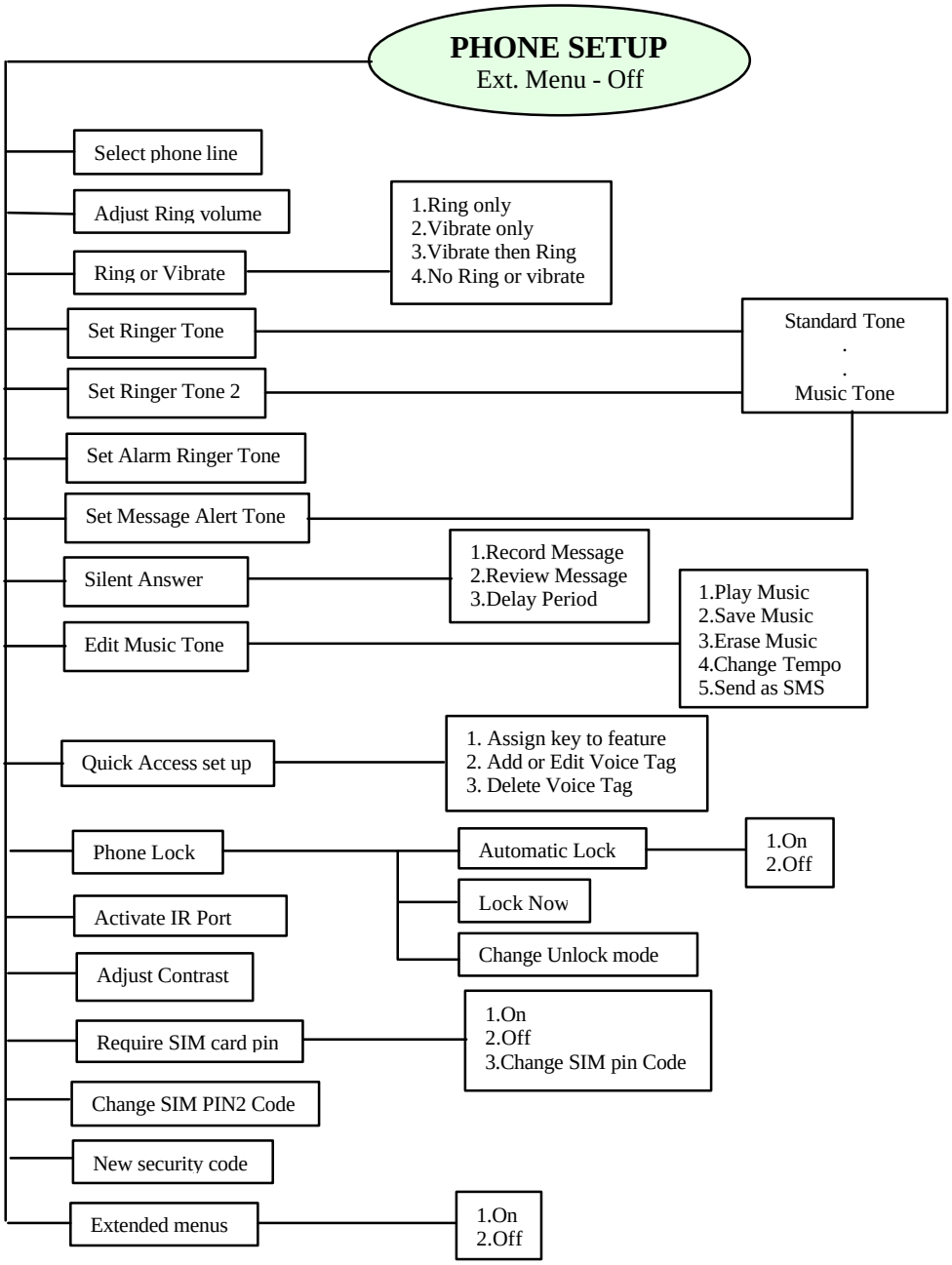
Below is the list of Menu functions available at present.

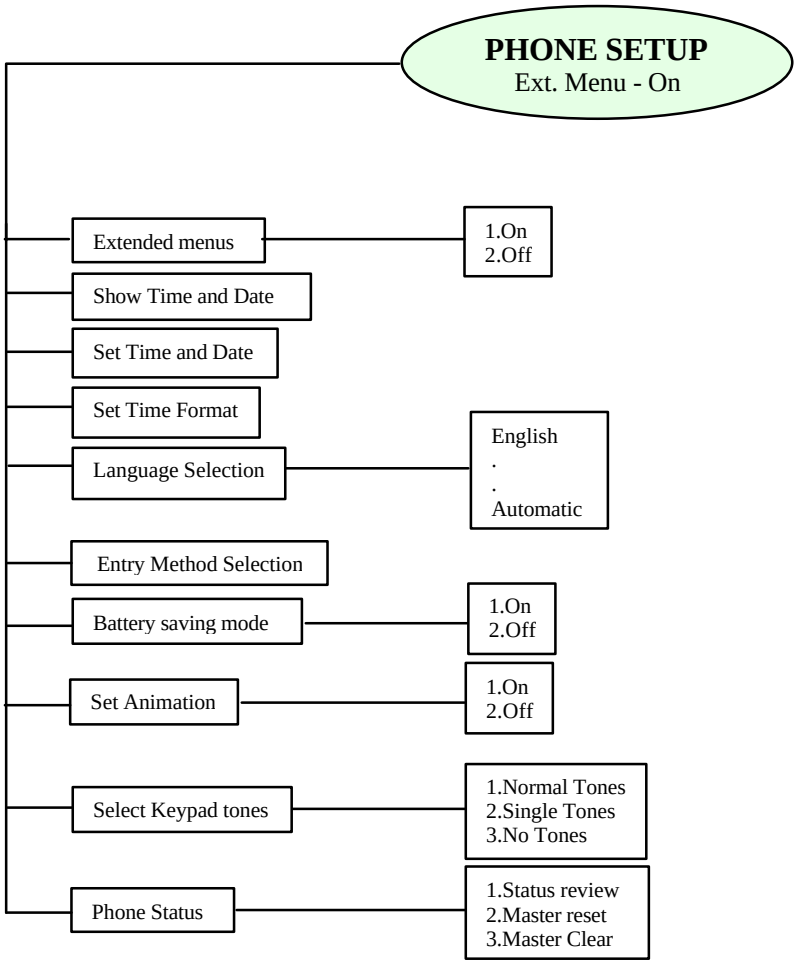


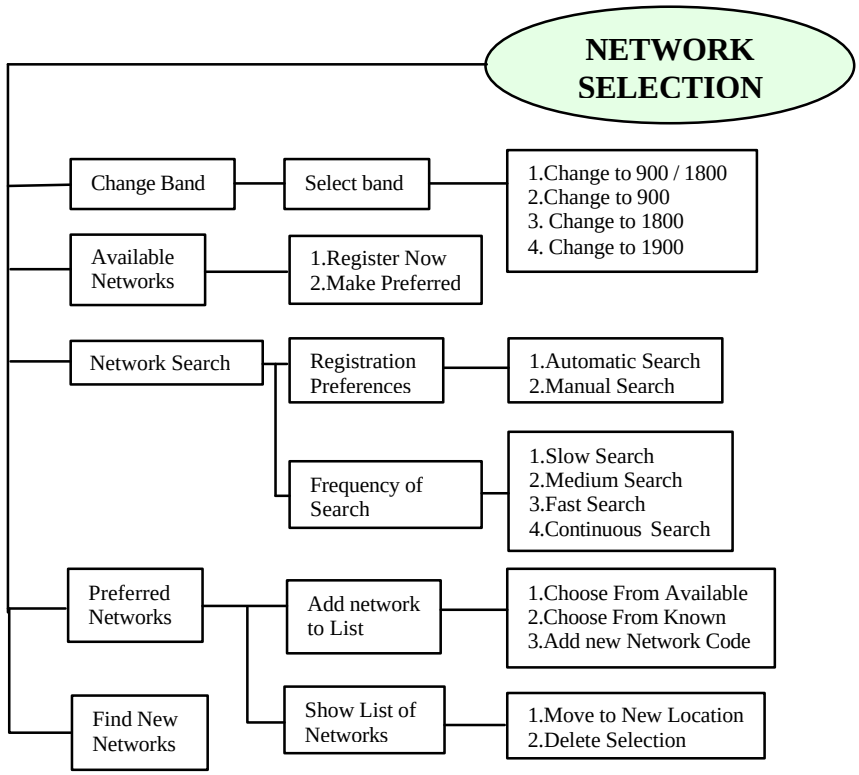


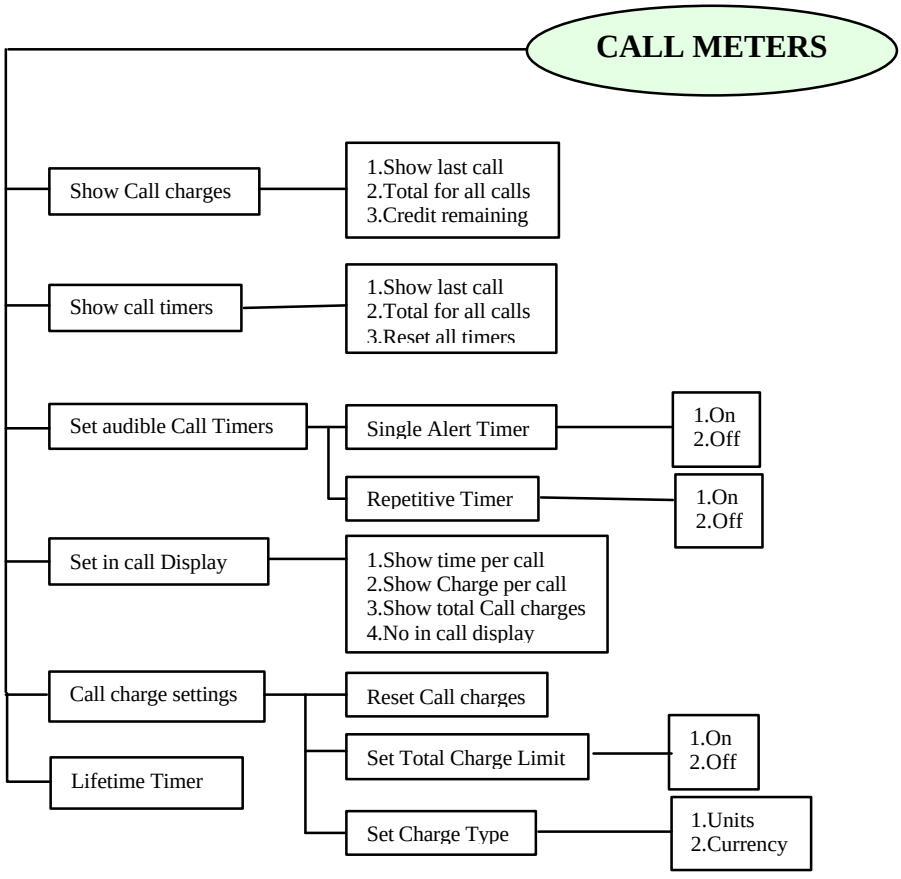

CALL RELATED FEATURES
Show battery meter
Restrict my Phone number
1.Show ID on next call
2.Restrict ID on next call
Call Diverting
Talk and Fax
1.On
2.Off
Call waiting
1.On
2.Off
Call Barring
Bar outgoing calls
1.Int'l Calls
2.Int'l Calls Except home
3.All Calls
4.Off
Bar Incoming Calls
1.When Roaming
2.All Calls
3.Off
Change Bar password
Cancel all barring
Key Answer Only (Flip Only)
1.On
2.Off
Divert Voice calls
Divert when unavailable
1.On
2.Off
Divert Fax Calls
1.On
2.Off
Divert all Voice calls
1.On
2.Off
Divert Data Calls
1.On
2.Off
Detailed Diverting
Cancel all diverting
If Busy
1.On
2.Off
If not reachable
1.On
2.Off
If No Answer
1.On
2.Off
Scheduled Diverting
1.On
2.Off

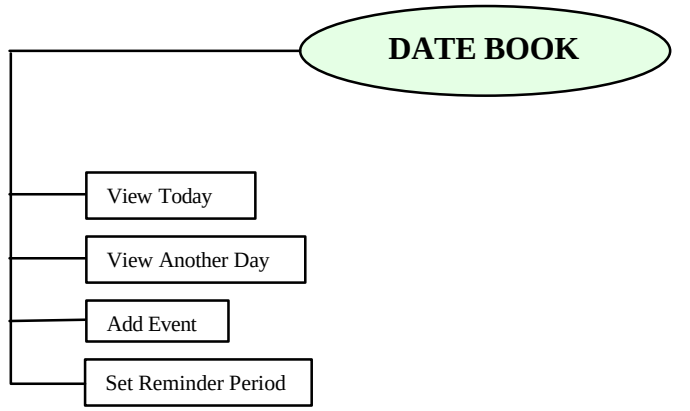

Messages
Call Voicemail
Answering Machine
Play New
Play All
Play Announcement
Record Announcement
Answering Machine – On / Off
Answer on X Rings
Mode – Audio/Silent
Received messages
Switch View
Delete Message
Retrieve Number
Reply to message
Return Call
Edit Message
1.Send Message
2.Store Message
Go to Next message
Delete all messages
Outgoing Messages
Switch View
Send message
Edit message
1.Send message
2.Store message
Delete message
Go To Next Message
Cell broadcast
On
Off
Channel List
1.Channel Index
2.Delete all Channels
Language List
Message Settings
1.Voicemail Number
2.Service Centre
3.Expiry Period
4.Outgoing message type
Message Editor
Edit Message
Send message
Enter Number
Store Message
Stored to Outgoing
Voice notes
Play Voice Notes
Go To Next
Show Time Available
Erase all Voice Notes

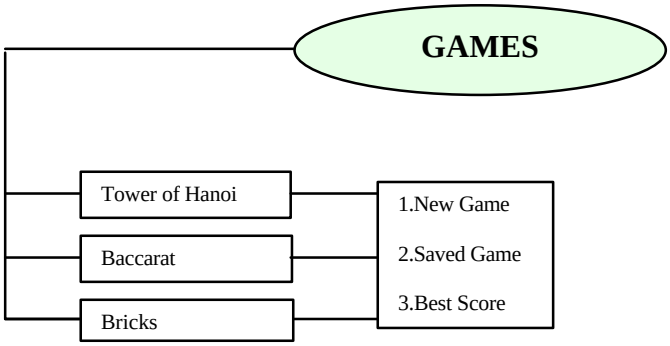

PHONE SETUP
Ext. Menu - Off
Select phone line
Adjust Ring volume
Ring or Vibrate
1.Ring only
2.Vibrate only
3.Vibrate then Ring
4.No Ring or vibrate
Set Ringer Tone
Set Ringer Tone 2
Standard Tone
.
.
Music Tone
Set Alarm Ringer Tone
Set Message Alert Tone
Silent Answer
1.Record Message
2.Review Message
3.Delay Period
Edit Music Tone
1.Play Music
2.Save Music
3.Erase Music
4.Change Tempo
5.Send as SMS
Quick Access set up
1. Assign key to feature
2. Add or Edit Voice Tag
3. Delete Voice Tag
Phone Lock
Automatic Lock
1.On
2.Off
Lock Now
Change Unlock mode
Activate IR Port
Adjust Contrast
Require SIM card pin
1.On
2.Off
3.Change SIM pin Code
Change SIM PIN2 Code
New security code
Extended menus
1.On
2.Off


PHONE SETUP
Ext. Menu - On
Extended menus
1.On
2.Off
Show Time and Date
Set Time and Date
Set Time Format
Language Selection
English
.
.
Automatic
Entry Method Selection
Battery saving mode
1.On
2.Off
Set Animation
1.On
2.Off
Select Keypad tones
1.Normal Tones
2.Single Tones
3.No Tones
Phone Status
1.Status review
2.Master reset
3.Master Clear

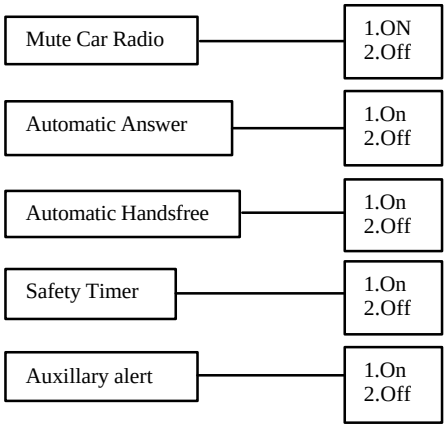

NETWORK SELECTION
Change Band
Select band
1.Change to 900 / 1800
2.Change to 900
3. Change to 1800
4. Change to 1900
Available Networks
1.Register Now
2.Make Preferred
Network Search
Registration Preferences
1.Automatic Search
2.Manual Search
Frequency of Search
1.Slow Search
2.Medium Search
3.Fast Search
4.Continuous Search
Preferred Networks
Add network to List
1.Choose From Available
2.Choose From Known
3.Add new Network Code
Find New Networks
Show List of Networks
1.Move to New Location
2.Delete Selection


CALL METERS
Show Call charges
1.Show last call
2.Total for all calls
3.Credit remaining
Show call timers
1.Show last call
2.Total for all calls
3.Reset all timers
Set audible Call Timers
Single Alert Timer
1.On
2.Off
Repetitive Timer
1.On
2.Off
Set in call Display
1.Show time per call
2.Show Charge per call
3.Show total Call charges
4.No in call display
Call charge settings
Reset Call charges
Set Total Charge Limit
1.On
2.Off
Lifetime Timer
Set Charge Type
1.Units
2.Currency





NB. THIS MENU IS ONLY AVAILABLE WITH EITHER HEADSET PLUGGED IN OR WHEN INSTALLED IN A CAR KIT.



SECTION 4: DISASSEMBLY & PARTS

4.1 Disassembly Introduction

The P7689 is held together by 5 screws. 2 of these screws are placed under the escutcheon, at the top of the phone.Unlike most products in the past there is no flex that holds the display module, this is held in place with 4 clips. Also note that unlike the P7389 instead of a sixth screw on the edge of the middle of the unit there is now a hinge see **Page 6**

Ensure that a properly grounded high impedance conductive wrist strap is used whilst performing any tasks during the disassembly and assembly of the unit

Avoid stressing the plastics in any way to avoid damage to either the plastics or internal components.

!! CAUTION !!

Many of the intergrated devices used in this equipment are vulnerable to damage from electro-static charges. Ensure that adequate static protection is in place when handling, shipping and servicing the internal components of this equipment.

4.2 Recommended Tools

The following tools are recommended for use during the assembly / disassembly of the P7689.

- Anti-static Mat Kit - 0180386A82, includes:
  Antistatic mat 66-80387A95
  Ground Cord 66-80334B36
  Wrist Band 42-80385A59

- Plastic Bladed Tool SLN7223A
- T6 Torx Driver

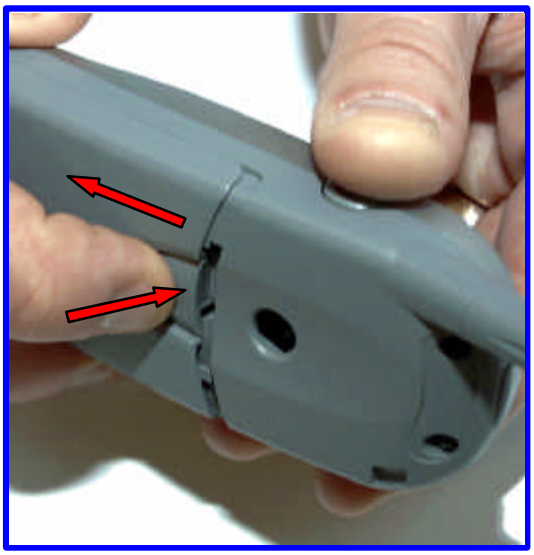
4.3 Disassembly Procedure

The following set of diagrams will demonstrate the correct sequence and action required to disassemble the P7689

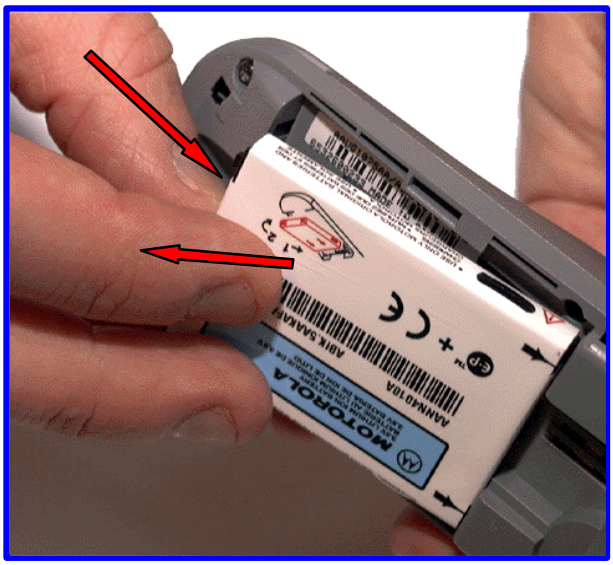
The use of the exploded diagram on pages **24 & 25** may be of some assistance for part recognition.

4.4 Assembly Procedure

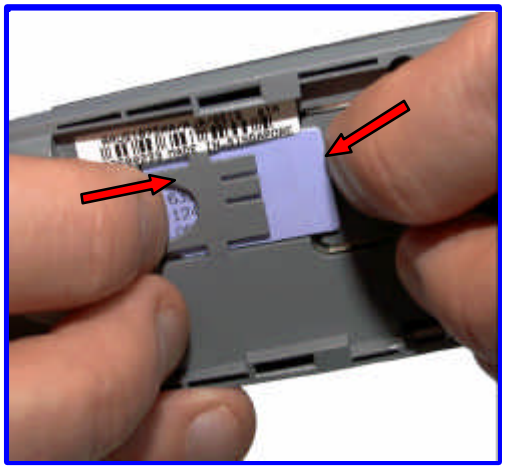
Once the unit is disassembled and the repair is carried out, the unit must then be reassembled, this is carried out in the exact reverse order as the disassembly. Although the housings are put back together parrallel to each other not ‘hinged’ apart as in disassembly.



1. Remove battery door by pressing down on clip and sliding back.



2. Remove battery by pushing and lifting at the same time.

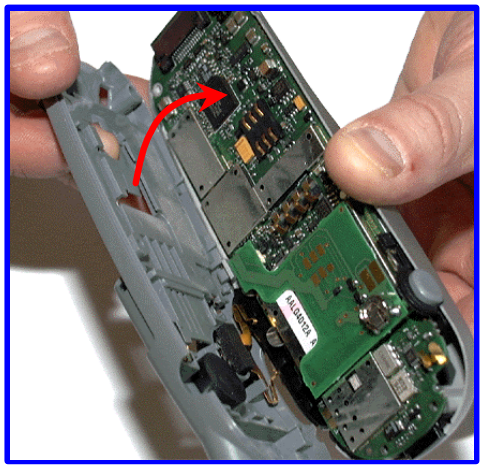


3. Press down on Panel at top of SIM and then push SIM from bottom upwards

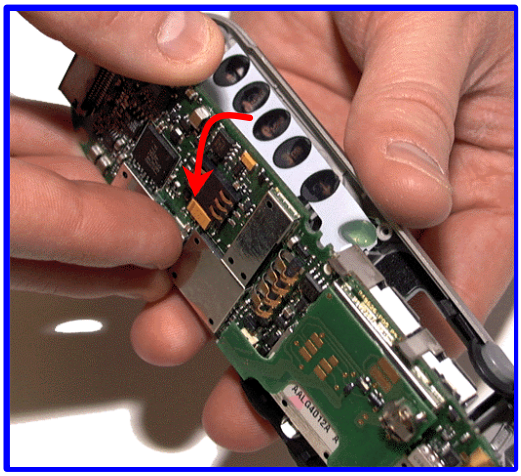
4. Remove Escutcheon from rear of unit.

5. Unscrew antenna (Anti – Clockwise)

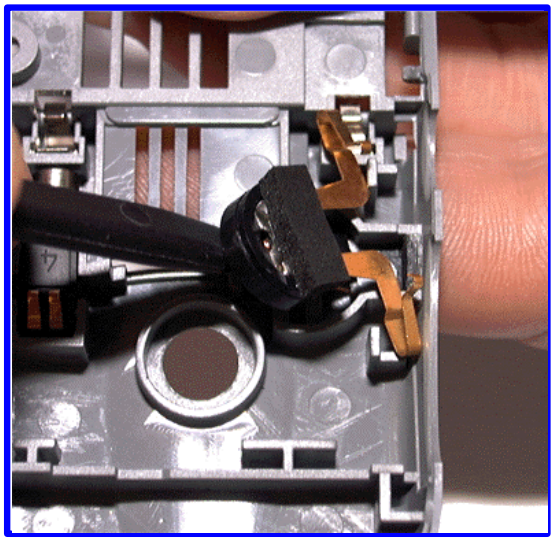
6. Unscrew all of the 6 screws.



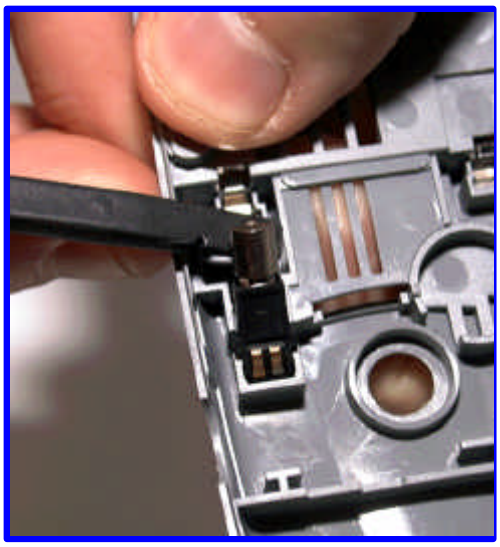
7. Remove the rear from the front housing, opening from the VA button side.



8. Levering from the side opposite the headset socket, carefully prize PCB from Front Housing.



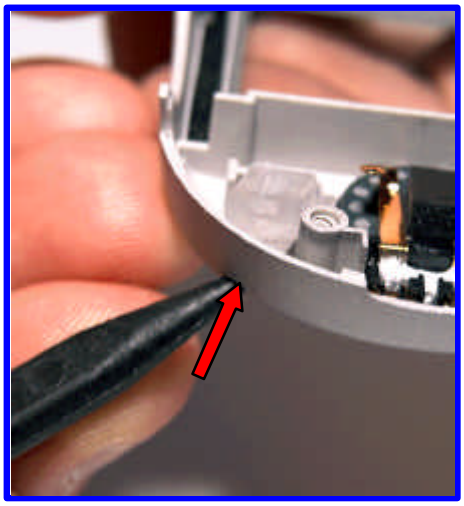
9. Remove Alert speaker from rear housing



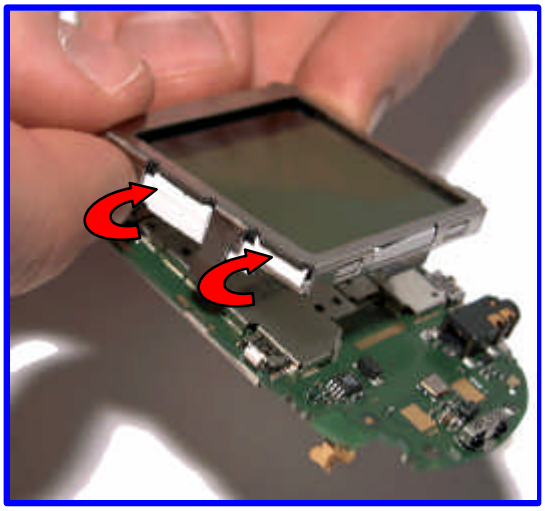
10. Remove vibrator from rear housing

13. Remove keypad from front housing

14.Remove volume switches from front housing.



15. Carefully press down on Service Indicator, if it gets damaged / scratched during this process, replace.

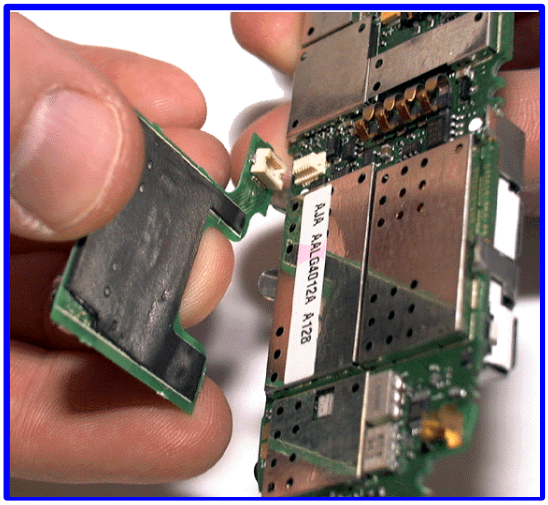


16. Unclip the 4 retaining catches remove the display module

17. Remove Infra- Red port cover by lifting upwards

18. Remove Microphone from front housing

19. Carefully prise speaker from front housing. Do not refit

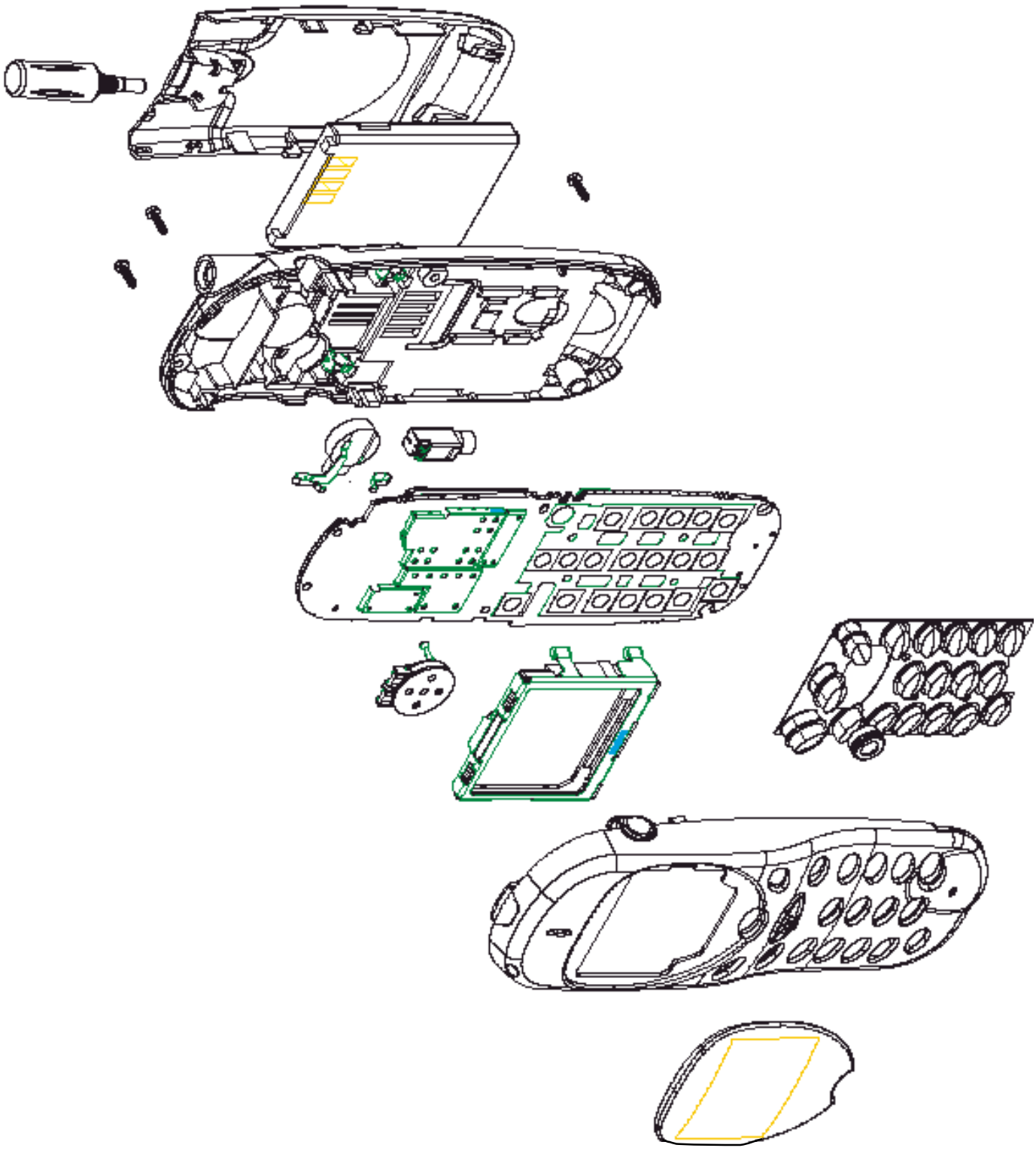


20. Remove RTC Battery board from main PCB. (Ensure this board is kept parallel to the main board to protect the connector)

4.5 Exploded Parts Diagram AAUG175AA

1	Full Tranceiver	9	Keypad	17	Antenna
2	Front Housing and Lens	10	Alert		
3	Rear housing	11	Vibrator		
4	Service Indicator	12	Rocker Switch		
5	Mic and Grommet	13	IrDA Cover		
6	Speaker	14	LCD		
7	Volume Switch	15	Batt Cover		
8	Screw	16	RTC Board		

4.5.1 Alternative Exploded Diagram



4.6 Part Numbers

Xcvr Item Number		AAUG1075AA	AAUG1077AA	AAUG1076AA	AAUG1078AA
Product	-	JADE	JADE	JADE	JADE
Additional Info	-	P7689	P7689	P7689	P7689
Colour	-	Silver	Titanium	Graphite	Aluminium
Make	-	Motorola	Motorola	Motorola	Motorola
System	-	GSM	GSM	GSM	GSM
Board level Kit	-	AALG4012AA	AALG4012AA	AALG4012AA	AALG4012AA
PCB Number	-	8486261P03	8486261P03	8486261P03	8486261P03
.. Frnt Hsng Kit	-	AAHN5304A	AAHN5331A	AAHN5305A	AAHN5332A
.. Frnt Hsng	-	1586335P01	1586335P03	1586335P02	1586335P04
..Speaker 20mm Sprng	-	5070371A02	5070371A02	5070371A02	5070371A02
..Display Module	-	7202879Z67	7202879Z67	7202879Z67	7202879Z67
..Button, Scroll (Integrated)	-	3886346P01	3886346P01	3886346P01	3886346P01
..Side Button (Vol Up/Down)	-	3886348P01	3886348P01	3886348P01	3886348P01
..Side Button (Vol/Note)	-	3886349P01	3886349P01	3886349P01	3886349P01
..Lens	-	6186338P01	6186338P01	6186338P01	6186338P01
..Rear Hsng Kit	-	AAHN5308A	AAHN5308A	AAHN5308A	AAHN5308A
..Rear Hsng	-	1586344P01	1586344P01	1586344P01	1586344P01
..Screw Torx Plus	-	0309315B07	0309315B07	0309315B07	0309315B07
H&H Parts	-				
..Jade Antenna	-	8586366P01	8586366P01	8586366P01	8586366P01
..Jade Antenna Insert	-	4385737J01	4385737J01	4385737J01	4385737J01
..Grommet	-	0585880J01	0585880J01	0585880J01	0585880J01
..Keypad	-	3886345P01	3886345P03	3886345P02	3886345P04
..Mic 6mm	-	5085600J01	5085600J01	5085600J01	5085600J01
..SW Array Domes	-	4086339P01	4086339P01	4086339P01	4086339P01
.. Eschuteon	-	Not Set Up	Not Set Up	Not Set Up	Not Set Up

SECTION 5: SIM CARDS AND SECURITY

5.1 Manual Test Mode

The GSM Motorola P7689 is equipped with a manual test mode capability. This capability allows service personnel to take control of the unit, and by entering certain keypad commands, make the unit performs desired functions.

To enter the manual test command mode, a GSM / DCS test sim (Part No 8102430Z04) must be used. The test sim is inserted into the SIM slot beneath the battery (See **figure 6.1**), the battery should then be re-inserted and the unit powered on. The # button should then be pressed for approximatly 3 second until 'test' appears on the display, and the correct commands must then be followed.

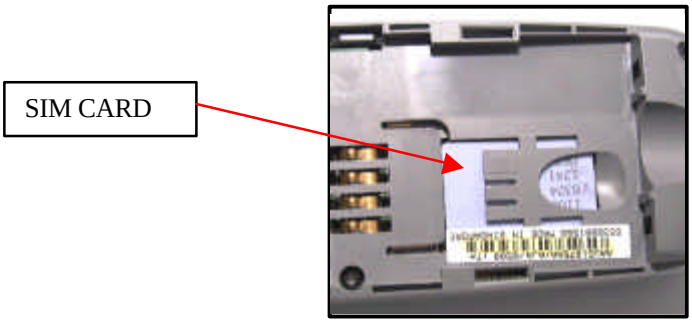


Figure 6.1 SIM Card insertion

5.2 Live Sim Card

A SIM (Subscriber Identity module) card will be required to access the existing local GSM / DCS / PCS cellular network, or remote networks when travelling. (If the roaming agreement has been made with the provider.)
The SIM card contains all the data necessary to access GSM services, and also:

- The ability to store user information such as phone numbers etc…
- All information required by the network provider to provide use to the network
- **For WAP Capability the SIM card must be Data enabled**

5.3 Personality Transfer

5.3.1 Introduction

Personality Transfers are required when a phone is Express Exchanged or when the main board is replaced. The reason for personality transfers are to reproduce the customer's original personalized details such as menu and stored memory such as phone books etc… or even just to program a unit with basic user information such as language selection. There are two possible methods of transferring this information from unit to unit, or with a master transfer, card to unit: -

• **Normal Transfer** is used when the customer's original unit still powers up and as discussed above the customers personalized menu selections etc… are required to be transferred to the replacement unit.

• **Master Transfer** is used when the faulty unit will not power up and the transfer is used to configure the replacement board to a set standard.

Below is the procedure to set up a Master Transfer Card and to carry out each method of transfer correctly.

5.3.2 Normal Transfer

1. Insert transfer card into 'Donor' Unit. Turn unit on till 'Clone' appears.
2. Enter **021#** to upload first block of data. 'Please wait' will be displayed.
3. Remove card.

4. Insert card into replacement unit, or unit with new main RF / Logic PCB.
5. Turn unit on wait till ‘Clone’ appears.
6. Enter **03#** ‘Please wait’ will be displayed while data is transferred.
7. Repeat steps 1 – 6 but enter **022#** at step 2 to transfer data on to Clone card.
8. Repeat steps 1 – 6 but enter **025#** at step 2 to transfer data on to Clone card.

5.3.3 Master SIM Card Creation

1. Insert transfer card into a unit with the desired setup Pwr on and wait till unit displays ‘Clone’
2. Enter **024#** to copy unit ‘personality’ onto card. ‘Please wait’ will be displayed
3. Master Transfer card is created.

5.3.4 Master Transfer

1. Insert Master Transfer Card (explained above) into replacement unit. Pwr on and wait till unit displays ‘Clone’
2. Enter **03#** to download data into replacement unit. Please wait will be displayed.
3. When ‘Clone’ reappears download is completed.

5.4 GSM Test Commands

This is a list of Level 1 and 2 Test commands available to P7689

Table 6.1 Test commands

Key Sequence	*Test Function/Name*
#(hold down for 2 seconds)	Enter manual test mode
01#	Exit manual test mode
07x#	Mute RX audio path
08#	Unmute RX audio path
09#	Mute TX audio path
10#	Unmute TX audio path
15x#	Generate tone
16#	Mute tone generator
19#	Display S/W version number of Call Processor
20#	Display S/W version number of Modem
36#	Initiate acoustic loopback
37#	Stop test
38#	Activate Mini SIM
39#	Deactivate Mini SIM
43x#	Change audio path
47x#	Set audio volume
51#	Enable sidetone
52#	Disable sidetone
57#	Initialize non-volatile memory
58#	Display security code
58xxxxxx#	Modify security code
59#	Display lock code
59xxx#	Modify lock code
60#	Display IMEI
99#	Display all display pixels

15XX#

90#	Vibrator
91#	Ringer

36XX#

0 or Omitted	Full Rate
1	Enhanced Full rate
2	Half Rate

98#

20#	GSM 1800
21#	GSM 900

5.5 Identity and Security

Each Motorola GSM Cellular Cassette will be labelled with various number configurations. The following information describes what these configurations mean.

MSN
The mechanical Serial Number (MSN) is an individual unit identity number and will remain with the unit throughout the life of the unit.
The MSN can be used to log and track a unit on Motorola's EPPRS system.
The MSN is divided into 4 sections.

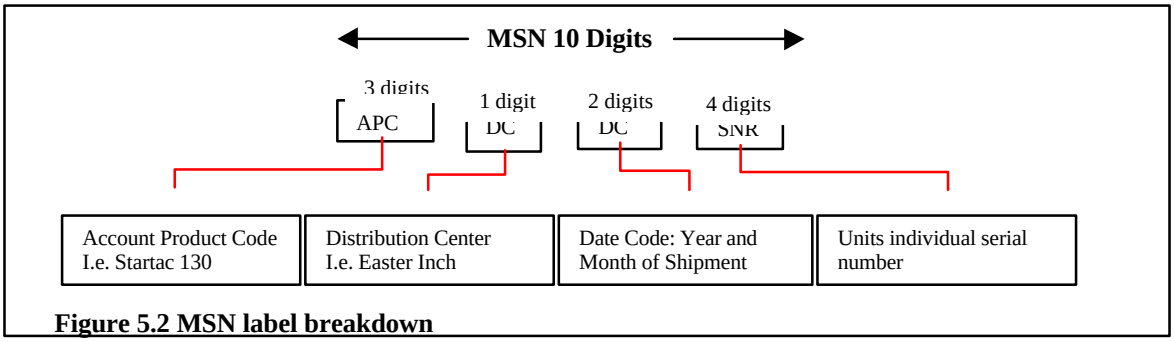


Figure 5.2 MSN label breakdown

IMEI
The International Mobile station Equipment Identity (IMEI) number is an individual number unique to the PCB and is stored within the unit's memory. The following figure gives a description of the make up of this number.

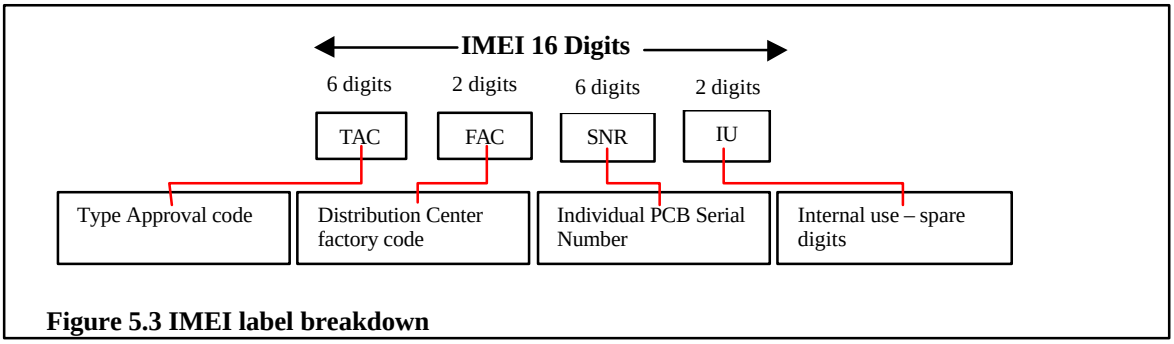


Figure 5.3 IMEI label breakdown

Some other label number configurations that will be present will be: -

XCVR NUMBER: Identifies type of product. i.e. P7689 (Usually SWF number)

PACKAGE NUMBER: Determines type of equipment, mode in which it was shipped and language with which it was shipped.

SECTION 6: REPAIR AND TEST PROCEDURES

6.1 Repair Introduction

The P7689 is divided into 3 main sections when it comes to part replacability: The housings which contains the alert, speaker, mic, the main PCB which contains RF / Logic circuitry and the keypad interface and finally the display module which connects to the main PCB via a elastomer connector. If the RF / Logic board is required to be changed then a full service tranceiver should be ordered as there is no replacement PCB available. Also a personality transfer would be necessary.

6.2 Mechanical repairs

Assembly replacement level troubleshooting and repair of the P7689 is limited to isolation and replacement of the main mechanical parts only (See Exploded parts diagram and associated parts list **p19 & p20**)

6.3 Basic Modular Troubleshooting

The troubleshooting information in **Table 2** shows some typical malfunction symptoms, and for the corresponding verification and repair procedures refer to the disassembly instructions located in the disassembly section of this manual. **(Section 4).**

NOTE

Defective Logic/RF assemblies must be replaced with pre-tested, pre-phased assemblies

Repair Chart

Table 2. GSM P7689 Cellular Telephone: Troubleshooting and Repair Chart. (Assembly Replacement Level).

SYMPTOM	PROBABLE CAUSE	VERIFICATION AND REMEDY
Personal telephone will not turn on or stay on	a) Battery pack either discharged or defective	Measure battery. If the battery voltage is <4.00 V dc, recharge the battery using the appropriate battery charger. If the battery will not recharge, replace the battery. If battery is not at fault, proceed to b.
	b) Battery connectors open or misaligned.	Visually inspect the 4 battery connectors on both the battery assembly and the portable telephone. If necessary, replace the battery. If battery is not at fault, proceed to c
	c) Logic/RF Board Assembly Defective.	Remove the Logic/RF Assembly. Substitute a known good assembly and temporarily reassemble the unit. Depress the **PWR** button; if unit turns on and stays on, disconnect the dc power source and reassemble the telephone with the new Logic/RF Board assembly (see personality transfer). Verify that the fault has been cleared. If the fault has not been cleared then proceed to d.
	d) Display circuit failure	Disassemble unit and remove LCD module and insert known good module. Insert Battery and depress **PWR** button. Ensure unit stays on, if OK reassemble unit in new housing assembly
2. Personal telephone exhibits poor reception and/or erratic operation (such as calls frequently dropping, Weak and/or distorted audio, etc.).	a) Antenna is defective	Check to make sure that the antenna pin is properly connected into the Logic/ RF assembly. If OK, substitute a known good antenna and test in a call. If the fault is still present, proceed to b.
	b) Logic/RF Board Assembly Defective.	Replace Logic/RF Assembly (refer to symptom 1c). Verify that the fault has been cleared and Re-assemble the unit with the new PCB.
3. Display is erratic, or provides Partial or no display.	a) Mating connections to / from LCD Module faulty.	Dissasemble unit, check display module is correctly seated on PCB display pads, if necessary refit or realign. If OK proceed to b.
	b) LCD module is Defective.	Substitute a known good LCD module onto the suspect board and connect to DC Pwr supply. Depress **PWR** and ensure display is now correct, if Ok rebuild unit with new LCD module if LCD module is not at fault proceed to c.
	c) Logic/RF Board Assembly Defective.	Replace Logic / RF Assembly (refer to symptom 1c). Verify that the fault has been cleared and Re-assemble the unit with the new PCB.

SYMPTOM	PROBABLE CAUSE	VERIFICATION AND REMEDY
4. Incoming call alert transducer audio distorted or volume is too low.	a) Faulty alert Transducer	Remove suspect alert transducer from rear housing and replace with known good alert. If fault does not clear proceed to b)
	b) Main RF / Logic PCB defective	Replace Logic/RF Board Assembly (refer to symptom 1c). Verify that the fault has been cleared

		and re-assemble the unit with the new PCB.
5. Personal telephone transmit audio is weak, (usually indicated by called parties complaining of difficulty in hearing voice from personal phone).	a) Microphone connections to The main RF / Logic board are defective.	Gain access to the Microphone as described in the DISASSEMBLY instructions in this manual. . Check connections. If connector is faulty proceed to c if the connector is OK, proceed to b.
	b) Microphone defective	Gain access to microphone. Disconnect and substitute a known good Microphone. Place a call and verify as heard by called party. If good, re-assemble portable with new Microphone. If Microphone is not at fault, re-install original Microphone and proceed to c.
	c) Logic/RF Board Assembly defective.	Replace Logic/RF Board Assembly (refer to symptom 1c). Verify that the fault has been cleared and re-assemble the unit with the new PCB.
6. Personal telephone receive audio is weak and/or distorted. (From speaker)	a) Connections to/from speaker and Logic/RF Circuit board defective.	Gain access to Logic/RF board as described in the DISASSEMBLY instructions in this manual. Check pads on the Logic/RF circuit board. Clean pads if necessary. If pad is at fault proceed to d. If connection is not at fault, Proceed to b.
	b) Earpiece Speaker defective.	Remove speaker from front housing and insert known good speaker. Place a call and verify improvement in earpiece audio. If better, reassemble the phone with the good speaker. If it was no better then proceed to c.
	c) Antenna assembly is defective.	Attempt a re-phasing of the unit and recheck the symptom. If symptom is the same but unit re-phases correctly, check to make sure the antenna connector is correctly soldered to the main board and that the antenna is fitted correctly. If ok, substitute a known good antenna assembly. If this does not cure the fault, re-install the original assembly then proceed to d.
	d) Logic/RF Board Assembly Defective.	d) Replace Logic/RF Assembly (refer to symptom 1c). Verify that the fault has been cleared and Re-assemble the unit with the new PCB.
7. Personal telephone will not recognize/accept SIM card	a) SIM card defective	Initially check that the contacts on the card are not dirty. Clean if necessary, and check if fault has been eliminated. If the contacts are clean, insert a Known good SIM card into the portable telephone. Power up the unit and confirm whether or not the card has been accepted. If the fault no longer Exists, the defective SIM card should be replaced. If the SIM card is not at fault, proceed to b.
	b) Logic/RF Board Assembly Defective.	Replace Logic/RF Board Assembly (refer to symptom 1c). Verify that the fault has been cleared and re-assemble the unit with the new PCB.
8. Phone does not sense when flip is Opened or closed **(L7789 Only)** (usually indicated by inability to answer incoming calls by opening the flip, or inability to make outgoing calls).	a) Magnet in flip defective	Replace Front / flip assembly with known good one, refer to the DISASSEMBLY instructions in this manual. Place call to portable phone and verify ability to answer by opening flip. If faulty rebuild phone with new front / flip Assy. If fault is still present, replace original front/flip assembly and proceed to b.

SYMPTOM	**PROBABLE CAUSE**	**VERIFICATION AND REMEDY**
	b) Logic/RF Board Assembly Defective.	Replace Logic/RF Board Assembly (refer to symptom 1c). Verify that the fault has been cleared and re-assemble the unit with the new PCB.
9. Internal Charger not working	a) Faulty charger circuit on main Board.	Test a selection of batteries in the rear pocket of the desktop charger. Check LED display for the charging indications. If these are charging ok, then the internal charger is at fault. Replace Logic/RF Board Assembly

		(refer to symptom 1c). Verify that the Fault has been cleared and re-assembles the unit with the new PCB.
10. No / Weak audio when using headset	a) Headset not fully pushed home	Fully ensure the 'click' is felt on the jack socket. If still at fault proceed to b)
	b) Faulty Jack Socket / Defective PCB	Replace Logic/RF Board Assembly (refer to symptom 1c). Verify that the fault has been cleared and re-assemble the unit with the new PCB.
11. No IrDA Connection	a) Alignment of handset / IrDA device	Ensure unit is no more than 25cm away from the IrDA device that will be talked to, also ensure as good as alignment as possible. If still no connection proceed to b)
	b) Remote Device faulty	Check unit against known good IrDA device to see if connection is made. If fault still present refer to c)
	c) Logic/RF Board Assembly Defective.	Replace Logic/RF Board Assembly (refer to symptom 1c). Verify that the fault has been cleared and re-assembles the unit with the new PCB.

6.4 Software Upgrade

For information on setting up and equipment required for the flashing of software, contact should be made with the local technical support engineer.
Flashing must take place using the Emmi2D box.

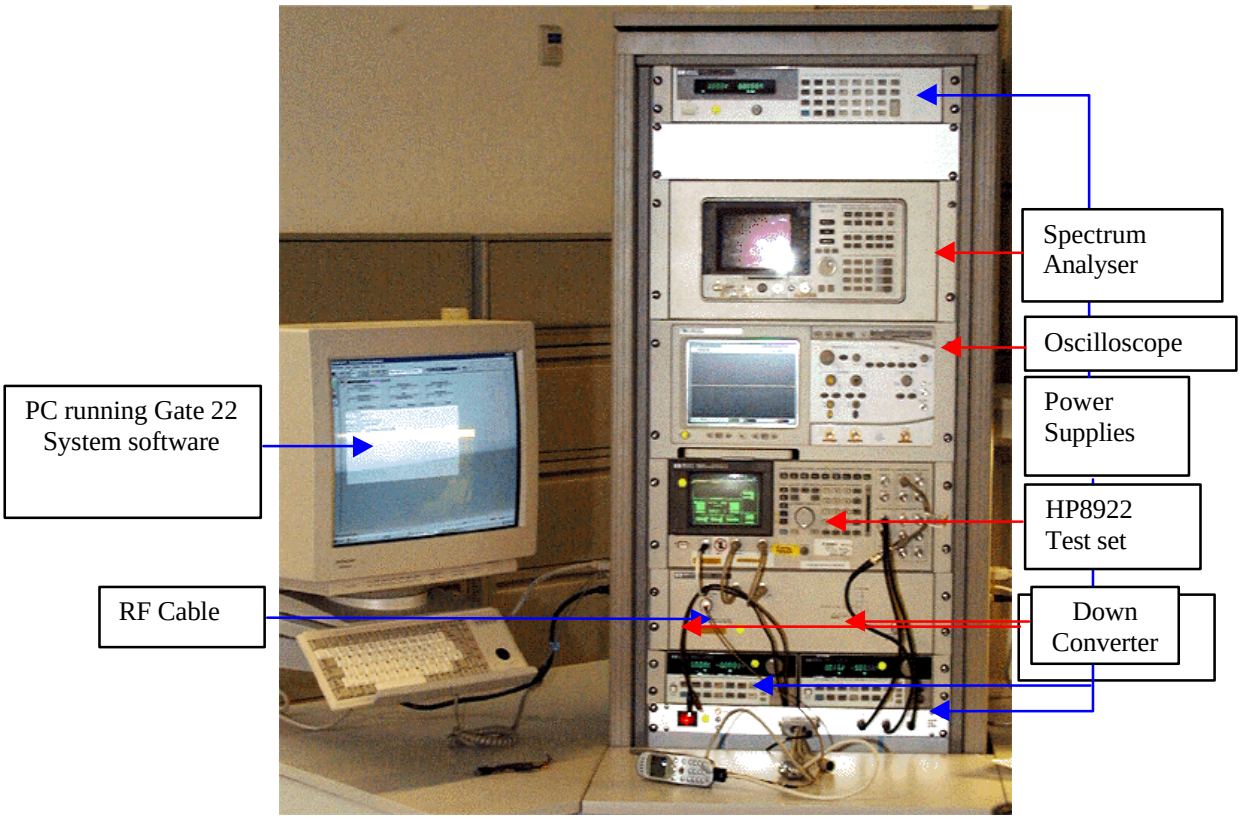
6.5 Flexing

For information on setting up and equipment for flexing, contact should be made with the local technical support engineer.

***IrDA does not support flashing or flexing, only Data transfer**

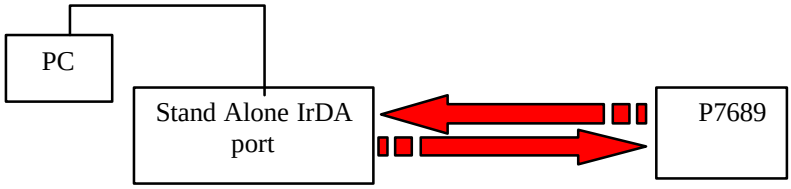
6.6 Testing on HP8922

NB* To test the PCB on its own without a housing or SIM card the unit must first be put into test mode and then into Tx or Rx mode using the applicable manual test commands. Ensure that a battery is present during this, as the battery acts as a SIM card presence detet for the unit. The PCB can then be taken out of the housing for any analysis.



6.7 Testing IrDA Port

To test the IrDA port the following set up should be followed, the distance between handset and IrDA port should be less than 30cm and although accurate alignment is not neccesary the two should be lined up as well as possible.
Note. Software is required for both the P7689 IrDA link and also the host IrDA port.
A CD Rom will be shipped with the unit to enable data transfer, the drivers for the host IrDA device should be supplied with the device. For testing all we are looking for is the discovery frame between PC and handset.



- **Please note this set up can only be used for Data Transfer not Flashing or Flexing. Also at present the truesynch software does not support Windows 2000.**

SECTION 7: ACCESSORIES

7.1 Introduction: The following is a short description of accessories available for the P7689 / L7089, that are currently available, a list of these with corresponding part numbers will follow shortly.

- Half Rate travel charger
  - Included in every package
  - Folding US blades built in
- Mini Rapid Desktop Charger
  - Can charge phone and second battery
  - Sliding door concept reduces size and improves portability
- Headset with Microphone and earpiece (PHFA)
  - Same headset as Zap (SYN6962)
  - No external adapter required
- Mini Pivoting Belt Clip
  - Belt remains on belt
  - Compact and light weight
  - Included in every package
- Leather carry cases
  - leather pouch stylish alternative to the plastic belt clip
- Cigarette Lighter Adapter
  - Same as StarTAC (SYN4241)
- Professional Install Digital Hands-free Car Kit
  - Includes new mini hang up cup
  - Easy one handed insertion
- Data cable (with level translators):
  - Allows full data and fax functionality without PC Card
- Range of Batteries
  - 600 mAh LiIon
  - 900 mAh LiIon

  Additional battery options available in the future

7.2 Mid-rate Charger Information

This is a linear DC supply that plugs into the charger socket of the unit and allows the user to simultaneously make and receive calls. A battery must be inserted for a call to take place. If a battery is completely dead the battery will charge for 30 secs.
Whilst in call the display will show 1 flashing 'Battery Level Bar', this will be re-assessed once the call has ended.
***AA Batteries will not be able to be used, as this will cause damage to the unit through overcharging.**

7.3 Accessory Listing

	Pno	Description	Responsible	Availability	Notes
PWR supplies	SPN4652	Mid rate switch mode charger	WW Accy	Mar-99	w/ US folding plug
Chargers & plugs	SPN4660	Mid rate switch mode charger (China)	WW Accy	Mar-99	w/ US folding plug
	SPN4604	Mini Rae Charger	WW Accy	Done	w/ US folding plug
	SYN7455	UK Plug	WW Accy	Done	
	SYN7456	Euro Plug	WW Accy	Done	
	SYN7457	Aus Plug	WW Accy	Done	
	SYN7458	Indian Plug	WW Accy	Done	
	SYN7460	Korea Plug	WW Accy	Done	
	SPN4608	DT charger (rapid 2-pocket)	Core LEAP	At Launch	
	SYN4241	CLA	Done	Done	Compatible w/ ST
Batteries	SNN5517	Li Slim LSQ6 600mAh	Core LEAP	At Launch	
	SNN5435	Li Slim LSQ6 530mAh	Core Kramer	Done	Compatible w/ V3688
	SNN5451	Li LSQ8	Core Kramer	Done	Compatible w/ V3688
Doors	SHN7094	Door Slim Blk	Core LEAP	At Launch	Li Poly & LSQ6
	SHN7239	Door Slim Galaxy Grey	Core LEAP	At Launch	Li Poly & LSQ6
	SHN7240	Door Slim Sea Blue	Core LEAP	At Launch	Li Poly & LSQ6
	SHN7905	Door Large Blk	Core LEAP	At Launch	LSQ8 & AAA Std
	SHN7241	Door Large Galaxy Grey	Core LEAP	At Launch	LSQ8 & AAA Std
	SHN7242	Door Large Sea Blue	Core LEAP	At Launch	LSQ8 & AAA Std
HeadSet	SYN6962	HeadSet w/ mic & earpiece in pouch	Done	Done	Same as V3688
	SYN5195	HATIS device	Done	Done	Same as 8700
Wearability Accy	SHN7175	Belt clip	Core LEAP	At Launch	
	SYN7915	Leather case (stays on phone)	Regional	At Launch	
	SYN7914	Leather case (stays on belt)	Regional	At Launch	
Data Accy	SKN4973	Data cadle w/ adapter and level x-lators	Communicate	Feb-99	Same as V3688
	T B D	Smart Cellect	Communicate	At Launch	
Car Kits	SYN7916	New HUC Assy	Core LEAP	At Launch	
	S8543	DSP prof install	Core LEAP	At Launch	
	S8464	DSP easy install HF carkit	WW Accy	Q2-99	HUC not Incl

SECTION 8: SALES MODEL NUMBERS

8.1 Sales Model Numbers

Market(s)	Transceiver	Model	Color	Lang.
The PRC	Flat	SA1522AD3X2	Silver	Sim C
Australia (SIM Lock)	Flat	SA1529AD3B1	Silver	English
New Zealand	Flat	SA1530AD3B1	Silver	English
Euro 1	Flat	SA1527AD3B1	Silver	English
Euro 2	Flat	SA1528AD3B1	Silver	English
India	Flat	SA1531AD3B1	Silver	English
Singapore	Flat	SA1525AD3B1	Silver	English
Philippines (US Plug)	Flat	SA1526AD3B1	Silver	English
Hong Kong	Flat	SA1524AD3X1	Silver	Comp C
Taiwan	Flat	SA1523AD3X1	Silver	Comp C
The PRC	Flat	SA1522AN4X2	Titanium	Sim C
Australia (SIM Lock)	Flat	SA1529AN4B1	Titanium	English
New Zealand	Flat	SA1530AN4B1	Titanium	English
Euro 1	Flat	SA1527AN4B1	Titanium	English
Euro 2	Flat	SA1528AN4B1	Titanium	English
India	Flat	SA1531AN4B1	Titanium	English
Singapore	Flat	SA1525AN4B1	Titanium	English
Philippines (US Plug)	Flat	SA1526AN4B1	Titanium	English
Hong Kong	Flat	SA1524AN4X1	Titanium	Comp C
Taiwan	Flat	SA1523AN4X1	Titanium	Comp C
The PRC	Flat	SA1522AP4X2	Aluminium	Sim C
Australia (SIM Lock)	Flat	SA1529AP4B1	Aluminium	English
New Zealand	Flat	SA1530AP4B1	Aluminium	English
Euro 1	Flat	SA1527AP4B1	Aluminium	English
Euro 2	Flat	SA1528AP4B1	Aluminium	English
India	Flat	SA1531AP4B1	Aluminium	English
Singapore	Flat	SA1525AP4B1	Aluminium	English
Philippines (US Plug)	Flat	SA1526AP4B1	Aluminium	English
Hong Kong	Flat	SA1524AP4X1	Aluminium	Comp C
Taiwan	Flat	SA1523AP4X1	Aluminium	Comp C

Market(s)	Transceiver	Model	Color	Lang.
The PRC	Flat	SA1522AQ4X2	Graphite	Sim C
Australia (SIM Lock)	Flat	SA1529AQ4B1	Graphite	English
New Zealand	Flat	SA1530AQ4B1	Graphite	English
Euro 1	Flat	SA1527AQ4B1	Graphite	English
Euro 2	Flat	SA1528AQ4B1	Graphite	English
India	Flat	SA1531AQ4B1	Graphite	English
Singapore	Flat	SA1525AQ4B1	Graphite	English
Philippines (US Plug)	Flat	SA1526AQ4B1	Graphite	English
Hong Kong	Flat	SA1524AQ4X1	Graphite	Comp C
Taiwan	Flat	SA1523AQ4X1	Graphite	Comp C
The PRC	Flip	SA1532AD3X2	Silver	Sim C
Australia (SIM Lock)	Flip	SA1539AD3B1	Silver	English
New Zealand	Flip	SA1540AD3B1	Silver	English
Euro 1	Flip	SA1537AD3B1	Silver	English
Euro 2	Flip	SA1538AD3B1	Silver	English
India	Flip	SA1531AD3B1	Silver	English
Singapore	Flip	SA1535AD3B1	Silver	English
Philippines (US Plug)	Flip	SA1536AD3B1	Silver	English
Hong Kong	Flip	SA1534AD3X1	Silver	Comp C
Taiwan	Flip	SA1533AD3X1	Silver	Comp C
The PRC	Flip	SA1532AN4X2	Titanium	Sim C
Australia (SIM Lock)	Flip	SA1539AN4B1	Titanium	English
New Zealand	Flip	SA1540AN4B1	Titanium	English
Euro 1	Flip	SA1537AN4B1	Titanium	English
Euro 2	Flip	SA1538AN4B1	Titanium	English
India	Flip	SA1541AN4B1	Titanium	English
Singapore	Flip	SA1535AN4B1	Titanium	English
Philippines (US Plug)	Flip	SA1536AN4B1	Titanium	English
Hong Kong	Flip	SA1534AN4X1	Titanium	Comp C
Taiwan	Flip	SA1533AN4X1	Titanium	Comp C
The PRC	Flip	SA1532AP4X2	Aluminium	Sim C
Australia (SIM Lock)	Flip	SA1539AP4B1	Aluminium	English
New Zealand	Flip	SA1540AP4B1	Aluminium	English

Market(s)	Transceiver	Model	Color	Lang.
Euro 1	Flip	SA1537AP4B1	Aluminium	English
Euro 2	Flip	SA1538AP4B1	Aluminium	English
India	Flip	SA1541AP4B1	Aluminium	English
Singapore	Flip	SA1535AP4B1	Aluminium	English
Philippines (US Plug)	Flip	SA1536AP4B1	Aluminium	English
Hong Kong	Flip	SA1534AP4X1	Aluminium	Comp C
Taiwan	Flip	SA1533AP4X1	Aluminium	Comp C
The PRC	Flip	SA1532AQ4X2	Graphite	Sim C
Australia (SIM Lock)	Flip	SA1539AQ4B1	Graphite	English
New Zealand	Flip	SA1540AQ4B1	Graphite	English
Euro 1	Flip	SA1537AQ4B1	Graphite	English
Euro 2	Flip	SA1538AQ4B1	Graphite	English
India	Flip	SA1541AQ4B1	Graphite	English
Singapore	Flip	SA1535AQ4B1	Graphite	English
Philippines (US Plug)	Flip	SA1536AQ4B1	Graphite	English
Hong Kong	Flip	SA1534AQ4X1	Graphite	Comp C
Taiwan	Flip	SA1533AQ4X1	Graphite	Comp C

SECTION 9: GLOSSARY OF TERMS

9.1 List of Abbreviations

Those marked ** are Motorola specific abbreviations.

µBGA	Micro Ball Grid Array
A Interface	Interface between MSC and BSS
A3	Authentication algorithm
A5	Stream cipher algorithm
A8	ciphering key generating algorithm
AB	Access Burst
A-bis	Interface between BSC and BTS
ACCH	Associated Control Channel
ACSE	Association Control Service Element
AGCH	Access Grant Channel
AMPS	Advance Mobile Phone System
AOC	Advice of charge
ARFCN	Absolute Radio Frequency Channel Number
ARQ	Automatic Request for retransmission
ASIC	Application Specific Integrated Circuit
AUC	Authentication Center
AUT (H)	Authentication
BA	BCCH Allocation
BAIC	Barring of All Incoming Calls
BAOC	barring of all Outgoing Calls
BCC	Base Transceiver Station (BTS) Color Code
BCCH	Broadcast Control Channel
BCD	Binary Coded Decimal
BGA	Ball Grid Array
BCU	BTS Control Unit **
Bm	Full-rate traffic channel
BN	Bit Number
BS	Base Station
BSC	Base Station Controller
BSIC	Base Transceiver Station Identity Code
BSS	Base Station System
BSSAP	BSS Application Part (DTAP and BSSMAP)
BSSC	Base Station System Control Cabinet **
BSSMAP	Base Station Systems Management Application Part
BSSOMAP	BSS Operation and Maintenance Application Part
BSU	Base Site Controller Unit **
BTS	Base Transceiver Station
CA	Call Allocation
CBCH	Call Broadcast Channel
cc	Call Control
cc	Country Code
CC	Cellular Cassette
CCBS	Completion of Calls to Busy Subscribers
CCH	Control Channel
CCCH	Common Control Channel
CDMA	Code Division Multiple Access
CFS	Call Forwarding on mobile Subscriber busy
CFU	Call Forwarding Unconditional
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CM	Connection Management

COLP	Connected Line identification Presentation
COLR	Connected Line identification Restriction
CONF	Conference Call add on
CSPDN	Circuit Switched Public Data Network
CUG	Closed User Group
CW	Call Waiting
DB	Dummy Burst
DBS	Distributed Base Station **
DCCH	Dedicated Control Channel
DET	Detach
DFE	Decision Feedback Equalizer
DISC	Disconnect
DL	Data Link (layer)
Dm	Control Channel (ISDN terminology applied to mobile service)
Dm	Signaling channel
Dp	Dialed Pulse
DRCU	Diversity Radio Channel Unit**
DRX	Discontinuous Reception
DTAP	Direct Transfer Application Part
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency (tone signaling type)
DTX	Discontinuous Transmission
E	erlang
Eb/No	Energy per Bit/Noise floor
EC	Echo Canceller
Ec/No	Ratio of energy per modulating bit to the noise spectral density
EGSM	Extended Group special Mobile
EFR	Enhanced Full Rate
EIR	Equipment Identity Register
EIRP	Effective Isotropic Radiated Power
EMC	Electromagnetic Compatibility
EMX	Electronic Mobile Exchange **
ETSI	European Telecommunications Standards Institute
FACCH	Fast Associated Control channel
FACCH/F	Full rate Fast Associated Control channel
FACCH/H	Half rate fast Associated Control channel
FB	Frequency correction burst
FCCH	Frequency Correction Channel
FEC	Forward Error Correction
FN	Frame Number
FR	Full Rate
FTAM	File Transfer Access Management
GCC	Global Call Center
GMSC	Gateway Mobile Services Switching Center
GMSK	Gaussian Minimum Shift Keying
GSM	Group Special Mobile
GSM MS	GSM Mobile Station
GSM PLMN	GSM Public Land Mobile Network
HANDO	Handover
HATIS	Hearing Aid Telephone Interconnection System
HDLC	High Level Data Link Control
HLR	Home Location Register
HOLD	Call Hold (Supplementary Service)

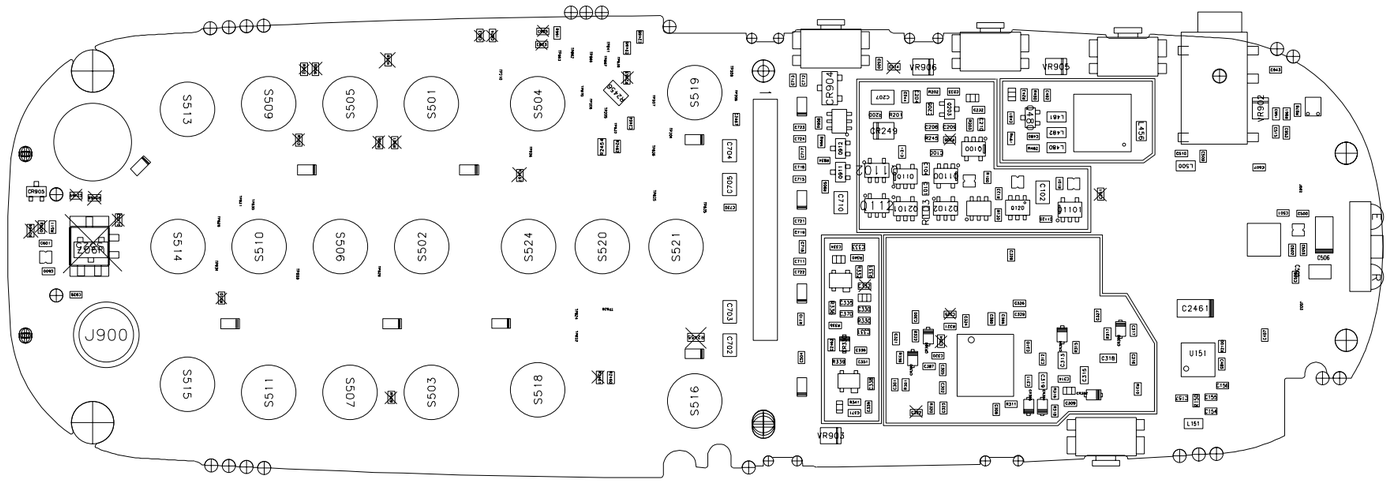
HPLMN	Home PLMN
HPU	Hand Portable Unit
HR	Half Rate
HSN	Hopping Sequence Number
I	Information (frames)
IA5	International Alphanumeric 5
ID	Identification
IMEI	International Mobile Equipment Identity
IMM	Immediate assignment message
IMSI	International Mobile Subscriber Identity
IN	Intelligent Network
INDY	Iridium 9500 handset
IrDA	Infra Red Data Association
ISC	International Switching Center
ISU	Iridium Subscriber Unit
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
IWF	Interworking Function
Kc	ciphering Key
Ki	Individual subscriber authentication key
LAC	Location Area Code
LAI	Location Area Identification (Identity)
LAPB	Link Access Procedure ‘B’ (balanced) channel
LAPDm	Link Access Procedure ‘DM’ (mobile ‘D’) channel
Lm	Traffic channel (with capacity lower than Bm)
LPC	Linear Predictive Code
LR	Location Register
MA	Mobile Allocation
MAH	Mobile Access Hunting
MAI	Mobile Allocation Index
MAIO	Mobile Allocation Index Offset
MAP	Mobile Application Part
MCC	Mobile Country Code
MCI	Malicious Call Identification
MD	Mediation Device
ME	Mobile Equipment
MF	Multi-Frequency (tone signaling type)
MLSE	Maximum Likelihood Sequence Estimator
MM	Mobility Management
MMI	Man Machine Interface
MNC	Mobile Network Code
MO	Mobile Originated
MO/PP	Mobile Originated Point to Point messages
MoU	Memorandum of Understanding
MRN	Mobile Roaming Number
MS	Mobile Station
MSC	Mobile Services Switching Center
MSCM	Mobile Station Class Mark
MSIN	Mobile Station Identification Number
MSISDN	Mobile Station international ISDN number
MSRN	Mobile Station Roaming Number
MT	Mobile Termination
MTP	Message Transfer Part
MT/PP	Mobile Terminated Point to Point messages

NAMPS	North American-Advance Mobile Phone System
NB	Normal Burst
NE	Network Elements
NET	Norme European de Telecommunications
NM	Network Management
NHC	Network Management Center
O&M	Operations and Maintenance
OACSU	Off Air Call Set-Up
OCB	Outgoing Calls Barred
OMAP	Operations and Maintenance Application Part (previously was OAMP)
OMC	Operations and Maintenance Center
OMCR	Operations and Maintenance Center -Radio Part
OMCS	Operations and Maintenance Center -Switch Part
OSI	Open System Interconnection
PAD	Packet Assembly Disassembly facility
PCH	Paging Channel
PDN	Public Data Networks
PIN	Personal Identification Number
PLMN	Public Land Mobile Network
POTS	Plain Old Telephone Service (basic telephone services)
PSPDN	Public Switched Packet Data Network
PSTN	Public Switched Telephone
PTO	Public Telecommunications Operator
QOS	Quality of Service
RAB	Random Access Burst
RACH	Random Access Channel
RBDS	Remote BSS Diagnostic Subsystem **
RBU	Remote Base Station Unit (PCN) **
RCU	Radio Channel Unit **
REC	Recommendation
REL	Release
RELP-LTP	Regular Pulse Excitation - Long Term Prediction
REQ	Request
RFCH	Radio Frequency Channel
RFN	Reduced TDMA Frame Number
RLP	Radio Link Protocol
ROSE	Remote Operations Service Element (a CCITT specification for O&M)
RXCDR	Remote Transcoder Unit **
RXLEV	Received signal level
RXQUAL	Received signal quality
SABM	Set Asynchronous Balance Model
SACCH	Slow Associated Control Channel
SAPI	Service Access Point Indicator (Identifier)
SB	Synchronization Burst
SC	Service Center
SCCP	Signaling Connection Control Part
SCH	Synchronization Channel
SCP	Service Control Point - an intelligent network entity
SDCCH	Stand-alone Dedicated Control Channel
SDL	Specification Description Language
SFH	Slow Frequency Hopping
SIM	Subscriber Identity Module
SMS	Short Message Service

SMSCB	Short Message Service Call Broadcast
SND	SeND
SP	Signaling Point
SRES	Signed RESponse (authentication)
SS	Supplementary Service
SS	System Simulator
STP	Signaling Transfer Point
SYSGEN	SYStem GENeration
TA	Terminal Adapter
TA	Timing Advance
TCAP	Transaction Capabilities Application Part
TCH	Traffic Channel
TCH/F	A full rate TCH
TCH/FS	A full rate speech TCH
TCH/HS	A half rate speech TCH
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TMN	Telecommunications Management Network
TMSI	Temporary Mobile Subscriber Identity
TN	Timeslot Number
TRX	Transceivers
TTY	TeleTYpe (refers to any terminal)
TS	Time Slot
TUP	Telephone Users Part
UI	Unnumbered Information frame
Um	Air Interface
USSD	Unstructured Supplementary Services Data
VAD	Voice Activity Detection
VLR	Visited Location Register
VLSI	Very Large Scale Integration (IC)
VPLMN	Visited PLMN
XC	Transcoder
XCDR	Transcoder **
3PTY	Three party service

P/N:8486261P05_P5

DO NOT PLACE:
R510,R509,R506,R504,R503,R502,R501,R500,R206,R505,R2455,
R2457,R2459,C322,C332,C825,C824,C823,C822,C514,C325,C304,C251,
C2469,C2470,R2461,R2463,R2458,S525,U907



NOTE:
FOR 2MEG SRAM PLACE R2461 DNP R2460
FOR 4MEG SRAM PLACE R2460 DNP R2461

JADE
P5
11 JAN 2000

MOTOROLA

Personal Communications Sector

GSM Service Support
Level 3 Authorized

P7689

GSM Service Support

Training - Documentation - Engineering

Level 3
Circuit Description
25 / 03 / 2000
V1.0

P7689 Level 3 Product Guide

RF: Receive

1) The RF Signal from the base station is received through the Antenna A1 or from the Accessory Connector J600 and is fed to **Pin 10** or **Pin 3** respectively of the RF Switch U150, the switch acts as an isolation between TX and RX. The RF Switch control is provided by U151.This decides whether the Switch is opened for TX or RX and if the RF is passed to the Aux RF port or the Antenna. This is managed by the following signals:

TX_EN	RX_EN	SW_RF (50W Load)	Result
H	L	Loaded	TX through J600
L	H	Loaded	RX through J600
H	L	Not Loaded	TX through Antenna
L	H	Not Loaded	RX through Antenna

2) **TX_EN** and **RX_EN** are produced by Whitecap U800, **Pins C1** and **E3** respectively.U151 is supported by the voltages **FILTERED –5V**(From **–5V** (U903)) and **RF_V1**(Q201)

3) Once the received signal is present (using GSM 900 as the example) in the RF switch. Provided **RX275_GSM_PCS** (Q2101) is high, then the received signal will be passed to the band pass filter FL400, GSM900received frequency will be filtered through, *Note **RX275_GSM_PCS** also selects the PCS 1900 frequency passed through FL2400. The DCS 1800 frequency is selected by **RX275_DCS** (Q110) and passed through FL1400

4) For the PCS 1900 and DCS 1800 frequencies the signal is then fed onto the DCS/PCS Select switch U400. The signal **RVCO_PCS** and **RVCO_DCS** (Q1100) will then select the appropriate signal; with output tuning being provided by L1411 and C1411 for DCS and C2411 for PCS.

5) Once selected the signal will be fed into a Low noise Amplifier Circuit, this part of the circuit is critical in the achievement of a very low signal to noise ratio, therefore as can be seen around the actual amplifiers Q400 for GSM (supported by **RX275_GSM** (Q110)) and Q1400 for DCS / PCS (supported by **RX275_DPCS** (Q2102)), a large amount of external frequency matching and noise reduction circuitry is involved.

6) The appropriate signal is then fed onto FL1401 (For GSM 1800 / 1900) or FL401 (For GSM 900) where any existing harmonics or other unwanted frequencies are removed.

7) The amplified signal is now injected to the base of the dual transistor mixer Q450. Both mixers are supported by **RX275** (Q112).The tuned emitter biasing voltage is provided by **RX275_GSM** (Q110) and **RX275_DPCS** (Q2102)

8) The RX VCO U250 is now an integrated circuit and is controlled firstly from the Whitecap using the **MQ SPI** bus to program the MAGIC and then MAGIC drives the RX VCO IC using the **CP_RX** signal **Pin A1**. The power is supplied by **RVCO_275** (**SF_OUT** + **GPO4** through Q1102).

9) The generated RX VCO signal is then split, with a part going back to the MAGIC IC – U200. **Pin A3** to serve as the feedback for the RX VCO Phase lock loop. The other part is firstly amplified through a Tuned Transistor Amplifier Q252, before being used to mix with the received frequencies through the emitters of the dual mixer transistor Q450.

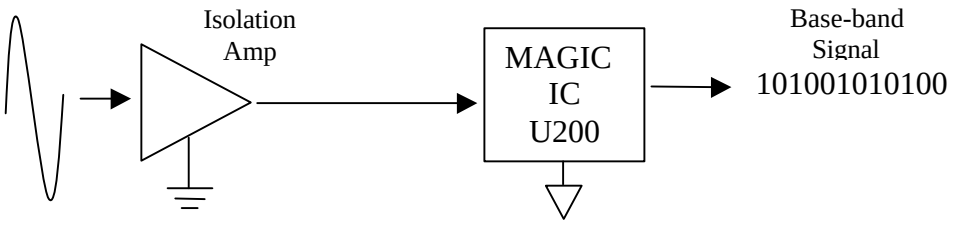
10) The mixer will produce sum and difference signals i.e. RX'ed frequency + RX VCO frequency and RX'ed frequency - RX VCO frequency. It will be the difference signal that is now fed to the SAW Filter FL457 (Surface Acoustic Wave), this filter is the same as was used in previous 400MHz products. The purpose of the SAW filter is to provide comprehensive removal of harmonics created during the mixing process.

11) The IF signal fed to the SAW filter will be 400Mhz. The reason for the change to 400Mhz from 215Mhz is to limit the span of the RX VCO e.g.

Description	IF	Channel	Received Frequency	RX VCO Frequency	Difference
EGSM L Channel	400Mhz	975	925.2Mhz	1325.2Mhz	264.6Mhz
PCS H Channel	400Mhz	810	1989.8Mhz	1589.8Mhz	
EGSM L Channel	215Mhz	975	925.2Mhz	1140.5Mhz	634.6Mhz
PCS H Channel	215Mhz	810	1989.8Mhz	1774.8Mhz	

As can be seen if the IF was kept at 215Mhz, the frequency span would have to be an extra **370Mhz.** This is turn assists in reducing the part count.

12) The 400Mhz IF signal is then passed to the Isolation Amplifier Q480
The purpose of an Isolation Amp is to couple an analogue signal to adjoining parts of a circuit with 2 different grounds. Also to protect the base band signals from any stray RF. The Isolation Amp is supported by **SW_VCC** (MAGIC U200 **Pin C7**)



13) The signal is then passed to the MAGIC IC U200 **PRE IN Pin A7**

14) The signal is then demodulated internally using an external 800 MHz Varactor diode CR249, RX Local Oscillator set up, which is driven by **PLL CP Pin A9** of MAGIC U200.

15) Where in earlier products, we used to have **RX RXQ, and I** these signals are now only used in digital form within the MAGIC and can only be measured using a specific set up. The demodulated signal is now converted internally to a base band digital form to be passed along an RX SPI bus to the Whitecap.

16) The **RX SPI** signal is made up of **BDR** (Base band Data Receive), **BFSR** (Base band Frame Synch Receive) and **BCLKR** (Base band Clock Receive, fed from MAGIC **Pins G8, G9 and F7** respectively.

17) The Whitecap U800 receives these signals on **Pins A3, D4 and B4,** within the Whitecap the signal is digitally processed. Baud rate reduced, Error correction bits removed, etc…

18) The digital signal is now being fed down the **DIG_AUD_SPI** bus to the GCAP II U900, internally to the GCAP, the digital signal is converted to analogue and distributed to the correct outputs:

19) For Earpiece speaker, from GCAP II **Pins H6 and H7** to speaker pads J502 and J503

20) The Alert is generated within the Whitecap, given the appropriate data from the incoming signal, SMS, call etc… and is fed to the alert pads J003 and J5004. This signal is supported by the signal **ALRT_VCC**, which is generated from B+ through Q903.

21) For the headset only the **SPKR-** signal is used from GCAP II **Pin H6**.The output is then fed out to the Headset Jack socket J504. **Pin 3.**

RF: Transmit

1) There are 2 Mic inputs, firstly from the Xcvr Mic J900, where the analogue input is fed to the GCAP II U900 **Pin J2.**

2) Secondly the analogue voice can be fed from the Aux Mic attached to the headset and will be routed from **connection 1** of the Headset Jack J504, through to GCAP II, **Pin H3**.

3) Within the GCAP II the analogue audio will be converted to digital and clocked out onto the **DIG_AUD** SPI bus to the Whitecap U800.

4) It is within the Whitecap that all information about the transmission burst is formulated i.e. The timing of the burst / The channel to transmit on / The error correction protocol / In which frame the information will be carried to the base station, etc, etc…

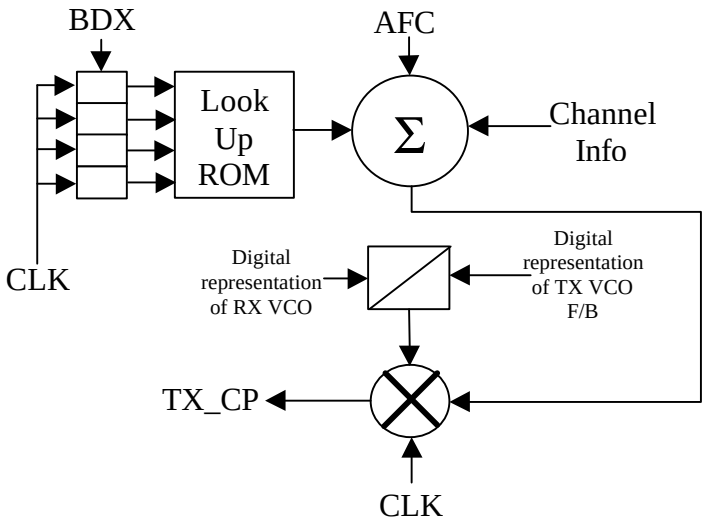
5) All this information is then added to the digitised audio and is transferred to the MAGIC U200 along a TX SPI bus. The bus is made up of **BCLKX** (Base band Clock Transmit) **Pin B3** and **BDX** (Base band Data Transmit) **Pin B6**. The timing for this data is already decided for the transmission burst, and therefore a frame synch is not required.

6) The SPI comes into the MAGIC at **Pin G7** (**BCLKX**) and **Pin J2** (**BDX**)

7) The operation of the MAGIC is very complex and with respect to the transmit path, integrates the functions of the Modem and its function of performing GMSK (Gaussian Minimum Shift Keying) and also the functions of the TIC (Translational Integrated Circuit).

8) A very basic block view of how the transmit path works within the MAGIC is demonstrated in: Fig 8.1

Internal MAGIC Operation **Fig 8.1**



9) The data is transmitted from Whitecap to MAGIC on TX SPI bus **BDX**, within the MAGIC each bit of data is clocked into a register. The clocked bit and the 3 preceding bits on the register are then clocked into the look up ROM, which looks at the digital word and from that information downloads the appropriate GSMK digital representation. Channel information and AFC information from MAGIC SPI is then

added to this new digital word, this word is then representative of the TX IF frequency of GIFSYN products. As in the case of the TIC, the TX frequency feedback and the RX VCO frequency are mixed to give a difference signal, this is digitally phase compared with the 'modulation' from the look up ROM. The difference creates a DC error voltage **TX_CP** that forms part of the TX Phase locked loop.

10) The error correction voltage **TX_CP** is then fed from **Pin B1** of MAGIC to **Pin 4** of the TX VCO IC U350, adjoining this line is the loop filter (See Loop Filter document).

11) The Loop filter comprises mainly of U360 / Q360 / Q361 and C367 and it's main function is to 'smooth' out any overshoots when the channel is changed, see Fig 11.1. If this overshoot were fed to the TX VCO the resulting burst would not meet the world standards for GSM with respect to bandwidth, see Fig 11.2.

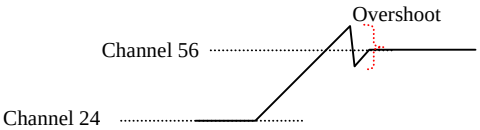


Fig 11.1

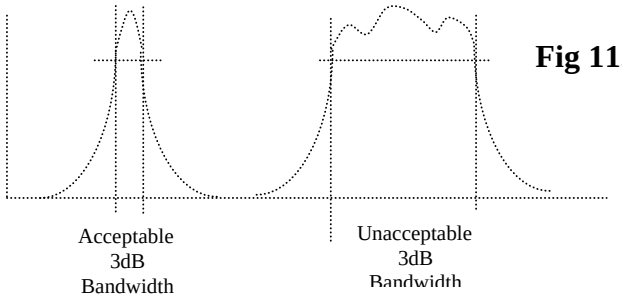


Fig 11.2

12) The Loop filter basically acts then as a huge capacitor and resistor to give a long CR time for smoothing. It uses a small capacitor and the very high input impedance buffer Op-Amp. During the **TX_EN** (Whitecap) period when the transmitter is preparing to operate the capacitor charges, then on receipt of **DM_CS** (Whitecap) when the Transmitter actually fires; the capacitor discharges through the Op-Amp giving a smooth tuning voltage, carrying modulation to the TX VCO. The support voltage for the Loop filter is **V1_FILT** (**V2** from GCAP II through Q913, then creates **V1_SW** which creates **V1_FILT**).

13) The TX VCO IC now creates our required output frequency with the support signals
TX_DCS (TX275 + *DCS_SEL through (U1101).
TX275_GSM (*GSM_SEL + RX275) (Q110)
TX275_DPCS (*GSM_SEL + RX275) (Q2102)
These signals configure the VCO for correct mode of operation i.e. GSM 900 / 1800 / 1900.
Support Voltage being **SF_OUT** (MAGIC **Pin C1**

14) The signal is then fed out through a buffer amplifier Q330, which is supported by **TX275.** The signal is also split with a sample of the output frequency being directed back to the MAGIC IC **Pin A3**, for use within the TIC part of the MAGIC as part of the TX Phase Locked Loop.

15) To prevent the output frequency from the TX VCO before stabilisation has occurred, being amplified and transmitted, there is an Isolation Diode CR320 placed. This is biased 'on' by the exciter voltage from the PAC IC U350 (Power Amplifier Control IC) **Pin 7**; this allows the TX output frequency through to the Exciter Amplifier Q331 and at same time gives more or less drive to the exciter stage.

16) The signal is then fed to a wide bandwidth PA U300, this is driven by the exciter voltage from the PAC IC, and supported by a –ve biasing voltage created and timed by **TX275** (**RF_V2 + TX_EN** through Q120), **Filtered –5V** (**-5V**) and **DM_CS** (Whitecap U800 **Pin E2**). Also supported by the voltage **PA B+** (**DM_CS + B+** through Q390)

17) PA matching is provided using the signals **TX_GSM** (**TX275 + *GSM_SEL** through Q1101) and TX_DCS (**TX275 + *DCS_SEL** through Q1101) to switch on or off the diodes CR300 through CR306 to match the PA between GSM and DCS / PCS using the inductive strips on the PCB.

18) The amplified signal is then fed back to the RF switch U150, as discussed in **Receive**, then either transmitted through the antenna A1 or the Accessory Socket RF Port J600 **Pin 2**

RF: Power Control Operation

1) The PAC IC U350 (Power Amplifier Control Integrated Circuit) controls the power control of the transmitter. Below is a list of the main signals associated with the PAC IC and their purposes.

2) The RF detector (**RF_IN Pin 2**) provides a DC level proportional to the peak RF voltage out of the power amplifier, this is taken via an inductive strip from the output of the PA U300.

3) **DET_SW Pin 11**. This pin controls the variable gain stage connected between the RF detector and the integrator. The gain of the variable stage will be unity when **DET_SW** is low and will be 3 when **DET_SW** is high (floating).

4) **TX_KEY Pin 10**. This signal is used to 'pre-charge' the Exciter and P.A. and occurs 20µS before the start of the transmit pulse.

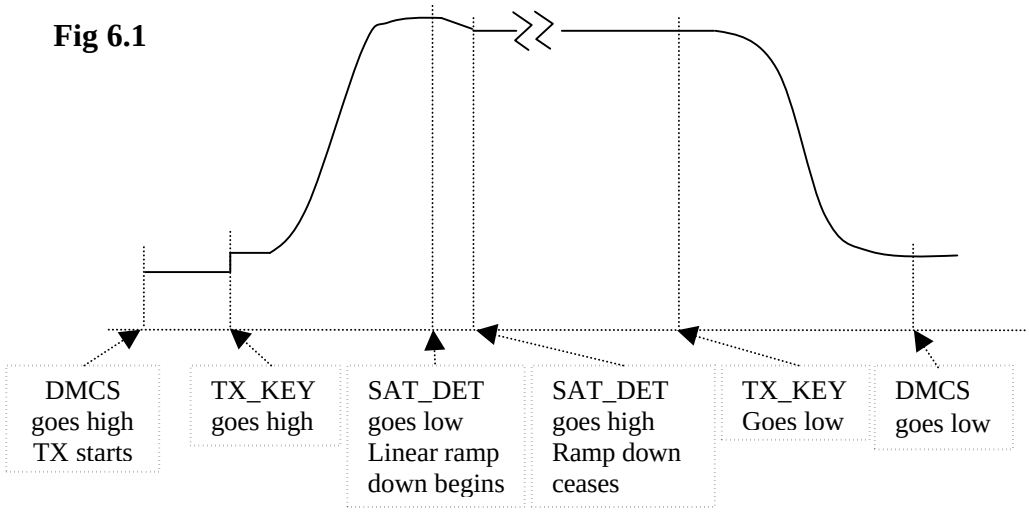
5) **EXC Pin 7**.This output drives the power control port of the exciter. An increase of this voltage will cause the exciter to increase its output power.

6) **SAT_DET Pin 12**. If the feedback signal from the RF detector lags too far behind the AOC signal then this output will go low, indicating that the loop in at or near saturation. This signals the DSP to reduce the **AOC_DRIVE** signal until **SAT_DET** rises. See **Fig 6.1**

7) **AOC_DRIVE Pin 8**. The voltage on this pin will determine the output power of the transmitter. Under normal conditions the control loop will adjust the voltage on EXC so that the power level presented to the RF detector results in equality of the voltage present at INT and AOC. The input level will be between 0 and 2.5V.

8) **ACT Pin 9**. This pin will hold a high voltage when no RF is present. Once the RF level increases enough to cause the detector to rise a few millivolts then this output will go low. In the GSM radio a resistor is routed between this point and the AOC input to cause the radio to ramp up the power until the detector goes active.

Fig 6.1


DMCS goes high TX starts
TX_KEY goes high
SAT_DET goes low Linear ramp down begins
SAT_DET goes high Ramp down ceases
TX_KEY Goes low
DMCS goes low

Logic: Power Up sequence

1) Three power sources available, battery, External Power via Charger **(Battery must be present to power up)**

2) Battery Power Source: The P7689 uses the slim 3.6V Lithium Ion battery AANN4010A. The power from the batteries is taken from **BATT +** (Battery contacts J604) and is routed through the Battery FET Q901. Once **B+** is available the unit carries out the following checks

- The battery temperature is monitored to establish whether rapid charge is required, (J604 **Pin 2 BATT_THERM_AD** to GCAP II **Pin B3**)
  -40 deg C – 2.75V 25 deg C – 1.39V 40 deg C – 0.96V
- Charger sensed (J600 Pin 5 **MANTEST_AD** to GCAP II **Pin A1**) This is achieved using different sense resistors within the accessory.
  For DHFA Charger - 2.75V For Fast Charger – 2.13V
  For Mid Rate Charger – 1.38V
- Senses battery voltage (GCAP II **Pin F7** – **BATTERY**)
- Senses input B+ level GCAP II **Pin E10** – **B+**)

3) Charger Power Source: As with L7389, the P7689 uses the mid rate charger. When the charger is connected into the accessory plug J600, **EXT B+** will be available at **Pin 14**. This will be sensed at GCAP II U900 **Pin D10 MOBPORTB**. Once sensed the power will then be passed through the protection diode CR903 and output to the EXT B+ FET Q905. The output will be controlled by the **Mid-rate 1** signal and power will be made available at **B+**
NB. The charger supports the phone in conjunction with the batteries, therefore the batteries are charged as **B+** is supplied.

4) The GCAP II is programmed to Boost mode (5.6V) by **PGB0 Pin G7** and **PGM1 Pin G8** both being tied to Ground. Once **B+** is applied to GCAP II **Pin K5**, all the appropriate voltages to supply the circuit are provided. These are:

- **V1** – Programmed to 5.0V. **V1** is at 2.775V at immediate power on, but is 'boosted' to 5.0V through the switch mode power supply L901 / CR902 and C913. See Fig 6.1 for basic operation. **V1** supplies the DSC bus drivers, negative voltage regulators and MAGIC. **V1** is created from GCAP II **Pin A6** and can be measured on C906.

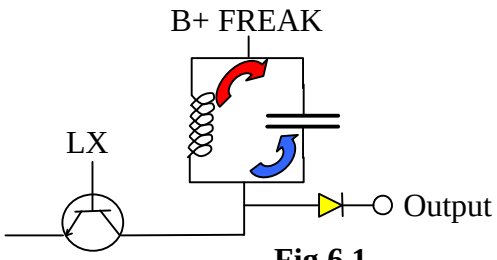


Fig 6.1

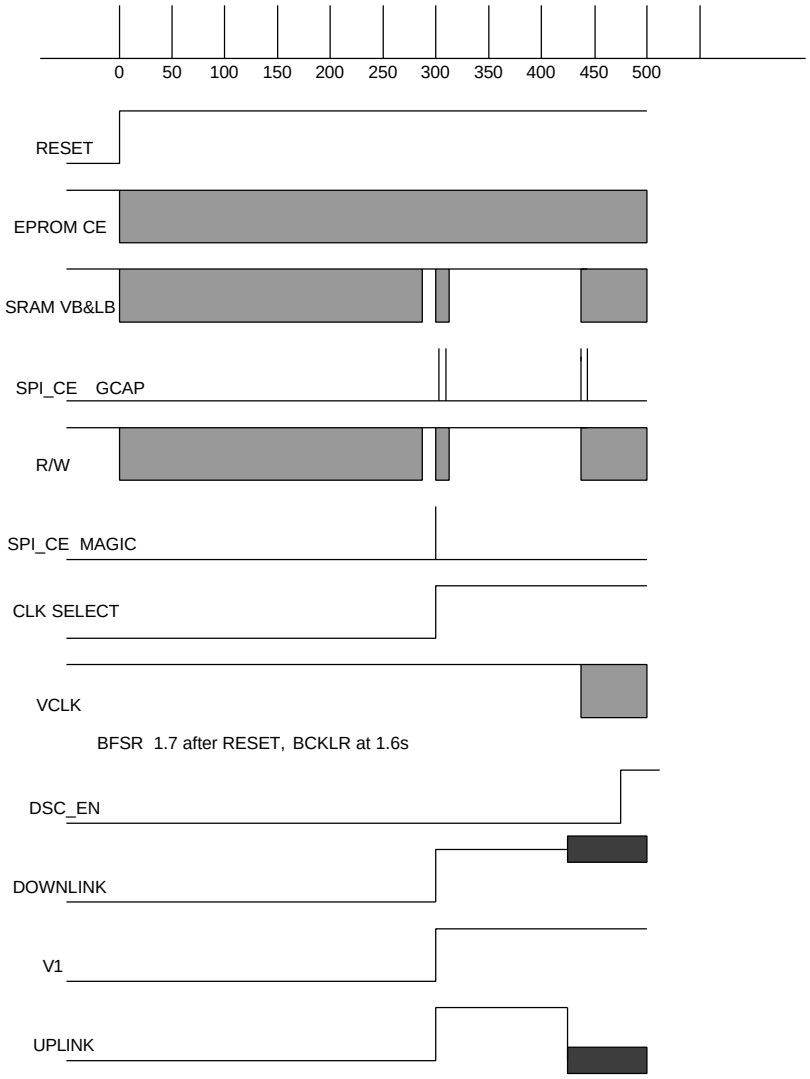
The basic circuit operation for the Boost circuit is as follows the **LX** signal (GCAP II **Pin B10**) allows a path for **B+** to charge the capacitor, when the switch is on, the capacitor then discharges through the inductor (switch off), setting up an electric field. The field then collapses setting up a back EMF to charge the capacitor, and so on and so on. The back EMF created by the inductor is greater than **B+** with the +ve half of the cycle passing through the diode to charge a capacitor from where the **V_BOOST** voltage is taken. The frequency of the switching signal **LX** decides the duty cycle of the output wave and therefore the resultant voltage. **V_BOOST** is fed back into the GCAP.

- **V2** – Programmed to 2.775V, available whenever the radio is on and supplies most of the logic side of the board. **V2** is supplied out of GCAP II **Pin J2** and can be measured on either C939 or C941.
- **V3** – Programmed to 2.003V to support the Whitecap, but does support the normal 2.75V logic output from the Whitecap, it originates from GCAP II **Pin B5** and can be measured on C909 or C910.
- **VSIM1** – Used to support either 3V or 5V SIM cards. Will dynamically be set to 3V upon power up, but if the card cannot be read then the SIM card is powered down and an attempt to read the card at 5V is tried. VSIM1 can be measured on C905 and is distributed from GCAP II **Pin C6** (For further information, see SIM Card Operation).

- **VREF** – Programmed as **V2** i.e. 2.775 and provides a reference voltage for the MAGIC IC, distributed from GCAP II **Pin G9** and can be measured on C919.
- **-5V –** Used to drive display and **–10V** – Used for RF GSM / DCS selection signals through Q160. Both voltages produced by **V1** through U903 and U904.
- **SR_VCC** – **Power Cut Circuit** - Used to buffer the SRAM U702 voltage with a built in soft reset within the unit's software. The reason for this is to protect the user from any accidental loss of power up to 0.5 seconds i.e. If the unit is knocked, causing a slight battery contact bounce, the **SR_VCC** will, to the user, keep the unit running normally, whilst internally the unit resets itself. During this loss of power the unit takes it's power from **RTC BATTERY+** and is originated from GCAP II **Pin E1**
- **V1_SW –** See **Deep Sleep Mode**

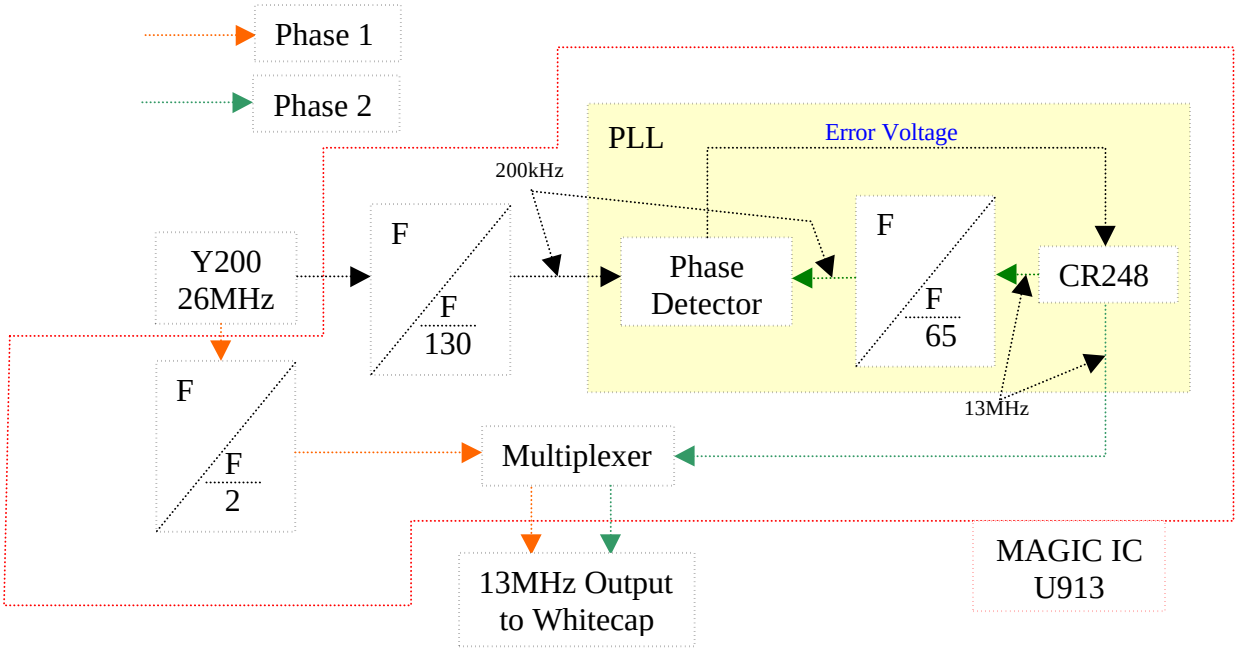
5) Once the power source has been selected to power the phone on the **PWR_SW** must be toggled low. This can be done by pressing the Power Key S500 to create **ON_2**, which is supported by **PWR_SW** (GCAP II **Pin C8**). Alternatively by plugging in an external fast charger, if a battery is present, then again the **ON_2** line will be pulled low.

6) The unit will then follow on as in the sequence below:



On initial power up, all the keypad backlights (DS504 – DS509 and DS513 and DS514) will be on, they are supported from the signal **ALRT_VCC** (B+ through Q903) and switched by **BKLT_EN** (Whitecap **Pin K3**) through Q907.Also the 'blue' display backlights (DS500 – DS503) which are supported by **V_BOOST1.**

7) **13 MHz clock**. On Power Up there are 2 different reference clocks produced. Initially, as soon as power is applied to the MAGIC IC the crystal, Y200, supported by the **CRYSTAL_BASE** (MAGIC **Pin E1**) will emit a 26MHz signal to the MAGIC IC, which will internally be divided by 2 to give our external 13MHz clock. This is then fed out of the MAGIC on **Pin J6** (**MAGIC_13MHz**) and distributed to Whitecap **Pin H10** (**CLKIN**), then from Whitecap **Pin B7** to GCAP II **Pin F5** as **GCAP_CLK**. At the same time the 13MHz Varactor Diode CR248 is producing an output. This output is controlled in the following way: The 26MHz from Y200 is divided down to 200 kHz and fed to a phase comparator within the MAGIC. The 13MHz from CR248 is also divided down and fed in to the phase comparator, the difference in phase produces an error voltage that is fed onto the cathode of the Varactor CR248. Which regulates the output to a stable 13MHz clock. Once the software is running and the logic side of the board has successfully powered up, the **CLK_SELECT** signal from Whitecap **Pin A1** is fed to MAGIC **Pin G6**. This in turn then switches the Multiplexer from the output of Y200 to the CR248 output.



Logic: SIM Card Interface

1) Once powered up, the SIM card is interrogated. The SIM interface is part of the Whitecap U800 and it supports both 'synchronous' (Prepay card) and asynchronous, serial data transmission. Although the T2288 is programmed only for asynchronous. **VSIM1** (**SIM_VCC**) is originally programmed to 3V but if the card is 5V then the SIM card will be powered down and **VSIM1** will be reprogrammed to 5V. The signal

levels for in and out of the SIM are now required to be level shifted within GCAP II U900 to 3V.these signals are:

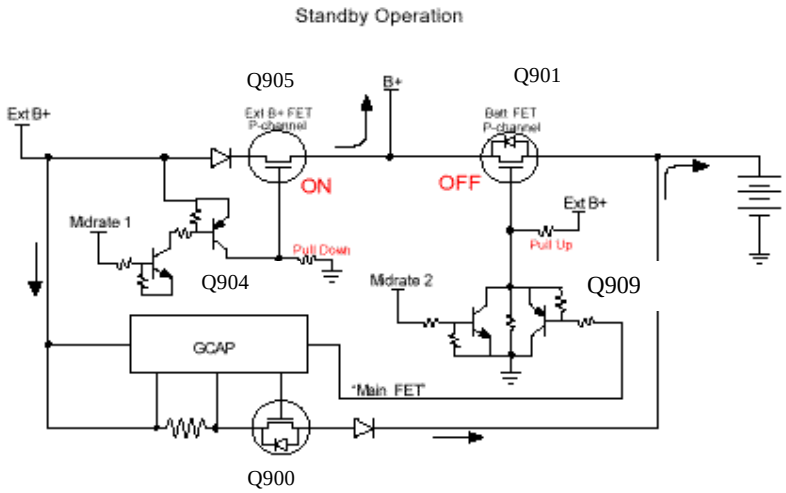
- **Reset** (Whitecap Pin E9 – **RST0**) in to GCAP II **Pin K7** – **LS1_IN_TG1A**. This signal is then level shifted to the required voltage and fed out to SIM Contacts J803 **Pin 4** from **Pin J7** - **LS1_OUT_TG1A**.
- Clock: This is a 3.25MHz signal from Whitecap **Pin E9** – **CLK0 Pin E7** to GCAP II **Pin G6** – **LS2_IN**. This signal is then level shifted to the required voltage and fed out to SIM Contacts J803 **Pin 6** from **Pin F6** – **LS2_OUT**.
- **SIM I/O** – Data transmission to and from SIM card; for TX, from SIM card contact **SIM I/O Pin 5** through to GCAP II **Pin J8 SIM I/O**. Through level shifter to desired voltage and out through **Pin K10** (**LS3_TX_PA_B+**) to Whitecap **Pin F3 DAT0_TX**. For RX data from Whitecap **Pin B5 DATA0_RX** to GCAP II, **Pin H8** – **LS3_RX** where the signal is level shifted to desired voltage and outputted on Pin J8 **SIM I/O** to SIM contacts **Pin 5 SIM I/O**.
- **SIM_PD** – This signal is provided by using the **BATT_THERM** contact of the battery. If there are no batteries present then the unit will not power up. If batteries are present, but colder than –15 deg C and no card is inserted then the output of the comparator Q905 will stay high and the unit will display 'Insert Card'. Once the battery temperature goes above that (**BATT_THERM** Voltage approximately 2.51V) but the SIM card is either not inserted or faulty 'CHECK CARD ' will be displayed. The reason behind this is to prevent the extra cost of a mechanical SIM presence detect switch and to prevent the SIM card being removed whilst connected to Aux Power.

Logic: Charger Circuit

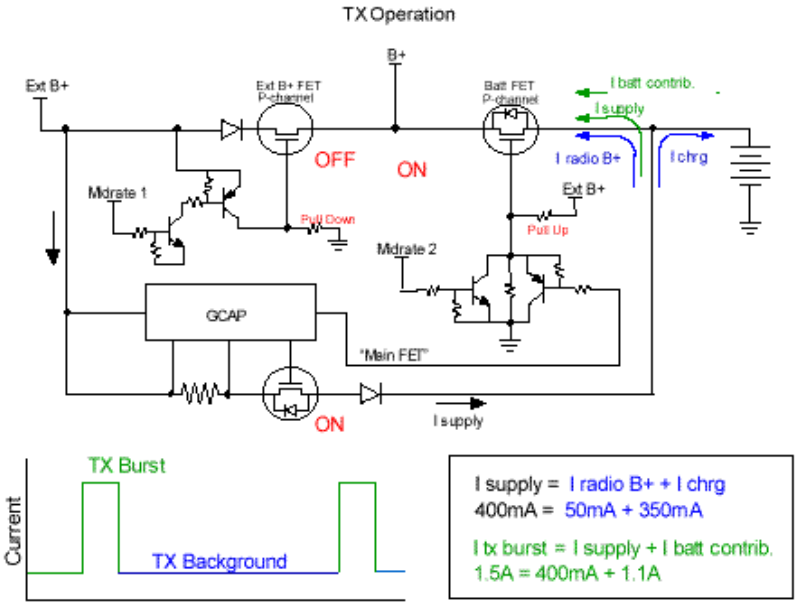
1) As was mentioned earlier for P7389 we use either the mid-rate charger or the full rate charger. The operation of which is as follows:

In standby, the phone requires approximately 50mA for support so Q905 is opened, and as the charger can support 400mA. The phone also opens Q900, controlled by **CHRGC** (GCAP II **Pin E8**). This allows a charge of 350mA to charge the battery. The current is monitored current sense resistor R913; the voltage drop over this resistor is looked at by GCAP II **Pin D9** – **I_SENSE**, to monitor the charge being delivered.

Mid-rate 1 = 0 **Mid-rate 2** = 0



Whilst in a Transmit mode of operation, the unit requires up to 1.5A to be supplied during each burst.



Whilst in background mode the phone operates as in standby mode with 50mA supporting the phone and 350mA charging the battery, but this time the EXT B+ FET Q905 is switched off and therefore the charger current is directed through the charging FET Q900. In this state **Mid-rate 1** = 0 **Mid-rate 2** = 1
During a TX pulse the full 400mA from the charger supports **B+** with addition to approximately 1.1A from the battery.
For this state **Mid-rate 1** = 1 **Mid-rate 2** = 1

Logic: Deep Sleep Mode

Deep sleep mode is there to provide a facility to save battery life by intermittently shutting off part of the PCB. This is achieved in the following way. The signal **STBY_DL** is generated from Whitecap **Pin F1**, through a standby delay circuit CR912 and U906. The logic gate U906 and diode CR912 are used to provide a short delay between the time of activation of the **STBY_PC5** signal and to the **STBY_DL** signal. This is a hardware patch for timing issues related to the Whitecap's Deep Sleep Module (DSM). The resultant signal is then passed onto Q834 and Q912. This has the effect respectively of:

1) Grounding **VREF** which makes MAGIC inoperable
2) Grounding **V2** This switches off MAGIC, Front END IC and inhibits the Transmit path through **RF_V2**
3) The shutdown is only for a fraction of a second and during that time the GCAP Clock supports the logic side of the unit. The GCAP clock is generated by Y900, which generates a 32.768MHz clock. This clock is output from Whitecap **Pin C7** and fed directly to Whitecap **Pin P4**. The clock is always monitored by Whitecap and should it fail, the unit will no longer go into deep sleep mode.

Logic: Keypad Operation

1) The keypad works as a matrix supported V2. The signals inform the Whitecap upon a key press by dropping the signal 'low'. Below is the Key Matrix.

	KBR0	KBR1	KBR2	KBR3	KBR4	KBC0	KBC1	KBC2	KBC3	KBC4	GND
KBR0	X	7	2	X	X	FAST ACCESS	X	OK	#	X	VA
KBR1	7	X	1	X	X	0	*	9	8	X	X
KBR2	2	1	X	MENU SCROLL DOWN	X	6	5	4	3	X	X
KBR3	X	X	MENU SCROLL DOWN	X	X	X	X	X	X	X	X
KBR4	X	X	X	X	X	X	X	X	X	X	X
KBC0	FAST ACCESS	0	6	X	X	X	VOL DOWN	VOL UP	MENU	X	X
KBC1	X	*	5	X	X	VOL DOWN	X	MAIL	CLEAR	X	X
KBC2	OK	9	4	X	X	VOL UP	MAIL	X	MENU SCROLL UP	X	X
KBC3	#	8	3	X	X	MENU	CLEAR	MENU SCROLL UP	X	X	X
KBC4	X	X	X	X	X	X	X	X	X	X	X
GND	VA	X	X	X	X	X	X	X	X	X	X

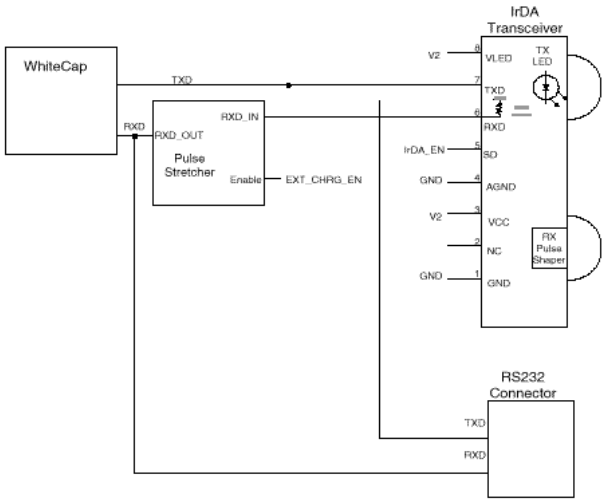
Logic: Display

1) The display is a 96 X 64 pixel graphics display and is connected to the PCB via a 16 Pin ZIF connector J902. It is made up of glass with polarizers, a display driver and transflector. It is connected to the PCB through an elastomeric contact. The LCD is controlled by:

- **CS1** Chip Select which originates from **DP_EN_L**, Whitecap **Pin A11** to J902 **Pin 1**.
- **RES** which originates from **RESET**, Whitecap **Pin P2** to J902 **Pin 2**.
- **R/W** which originates from **R_W**, Whitecap Pin P2 to J902 Pin 4.
- 7 Data Lines from Whitecap **DO – D7**
- The display is supported by **V2** and **–10V (**originating from U904 and can be measured on C965)
- Also the data / command signal **AO** from Whitecap **Pin B12**.

Logic: IrDA

1) The IrDA port is used in conjunction with the Truesync Software to transfer data between various applications. This as yet cannot be used for flashing and flexing of the phone's software.
The block diagram of the IrDA module U500 circuit can be seen in Fig 1.1 below



2) The IrDA data takes the form of an SIP (Serial Infrared Pulse) with **UTXD** being an active high signal that turns the LED on. The received signal **URXD** is always a pulsed, active low 2.4µs pulse, and a low will light the LED.

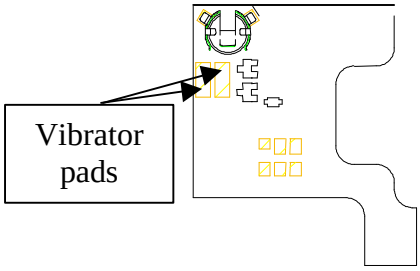
3) The signal **IrDA_EN** (Whitecap **Pin B2**) turns off the transmitter and opens the receiver path.

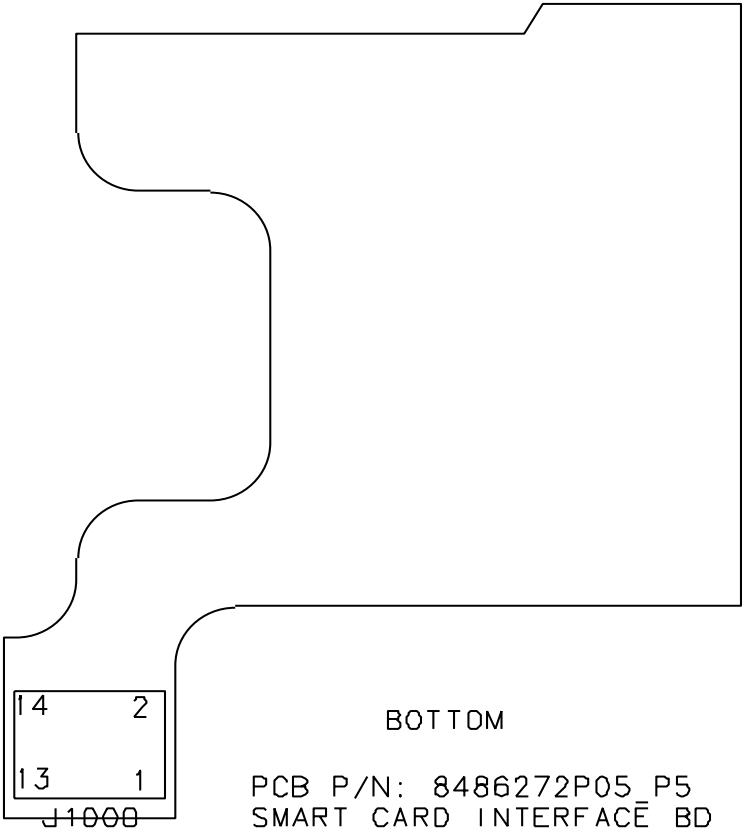
4) Within the module the pulse stretcher is integrated to allow compatibility between the received signal and Whitecap.

5) The module is supported by **V2**

Logic: Vibrator

1) The vibrator contacts are now situated on the topside of the smart card PCB
2) The vibrator is controlled by the signal **VIB_EN** Whitecap **Pin K1** and **B+** through U501
3) U501 connects to the vibrator pads through Connector J5006 **Pins 2** and **4**





BOTTOM

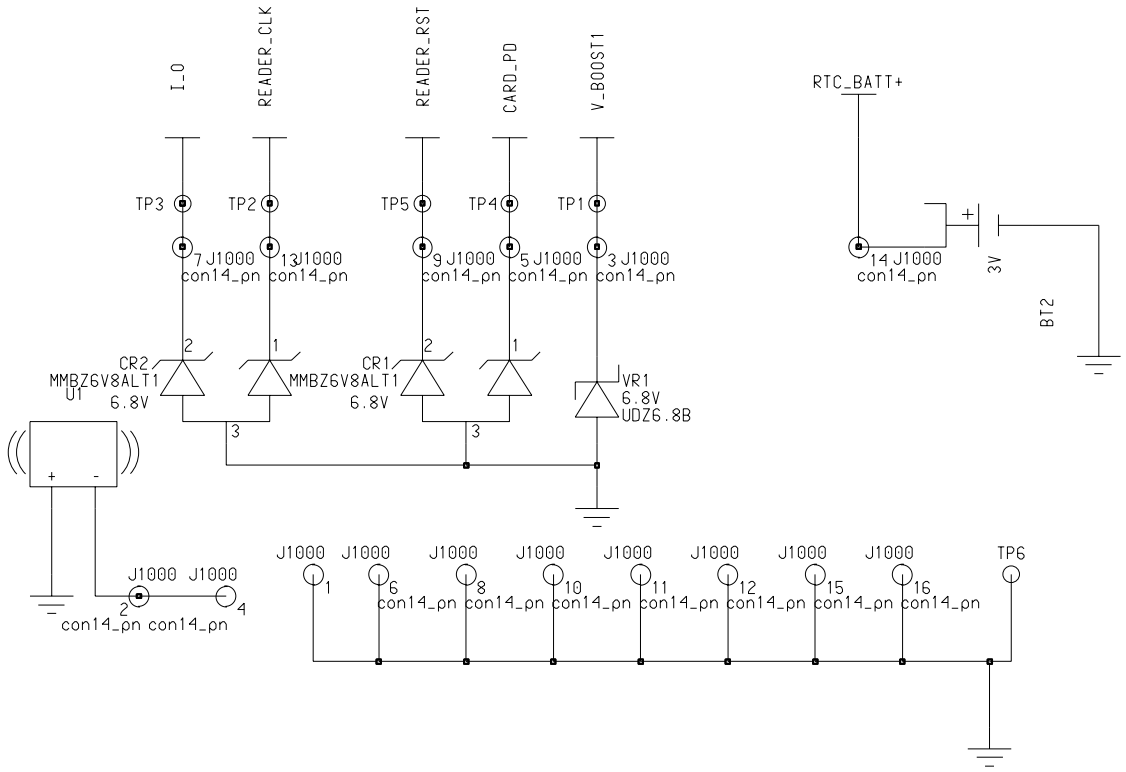
PCB P/N: 8486272P05_P5
SMART CARD INTERFACE BD

Smart Card Interface Board

84D86272P05

SHEET 1

ISS.	COMMENTS	DATE
P5		14/02/2000



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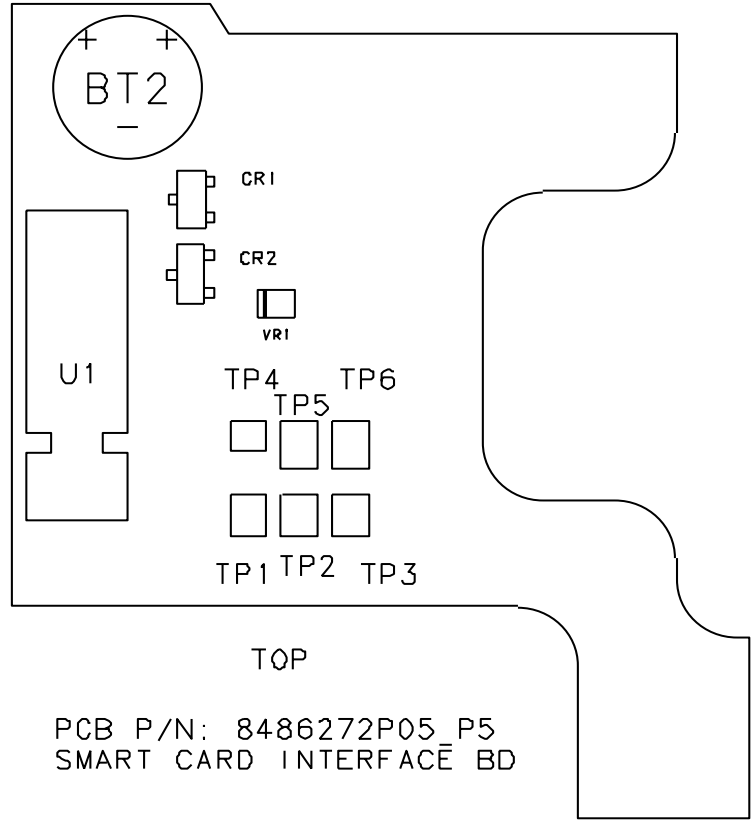
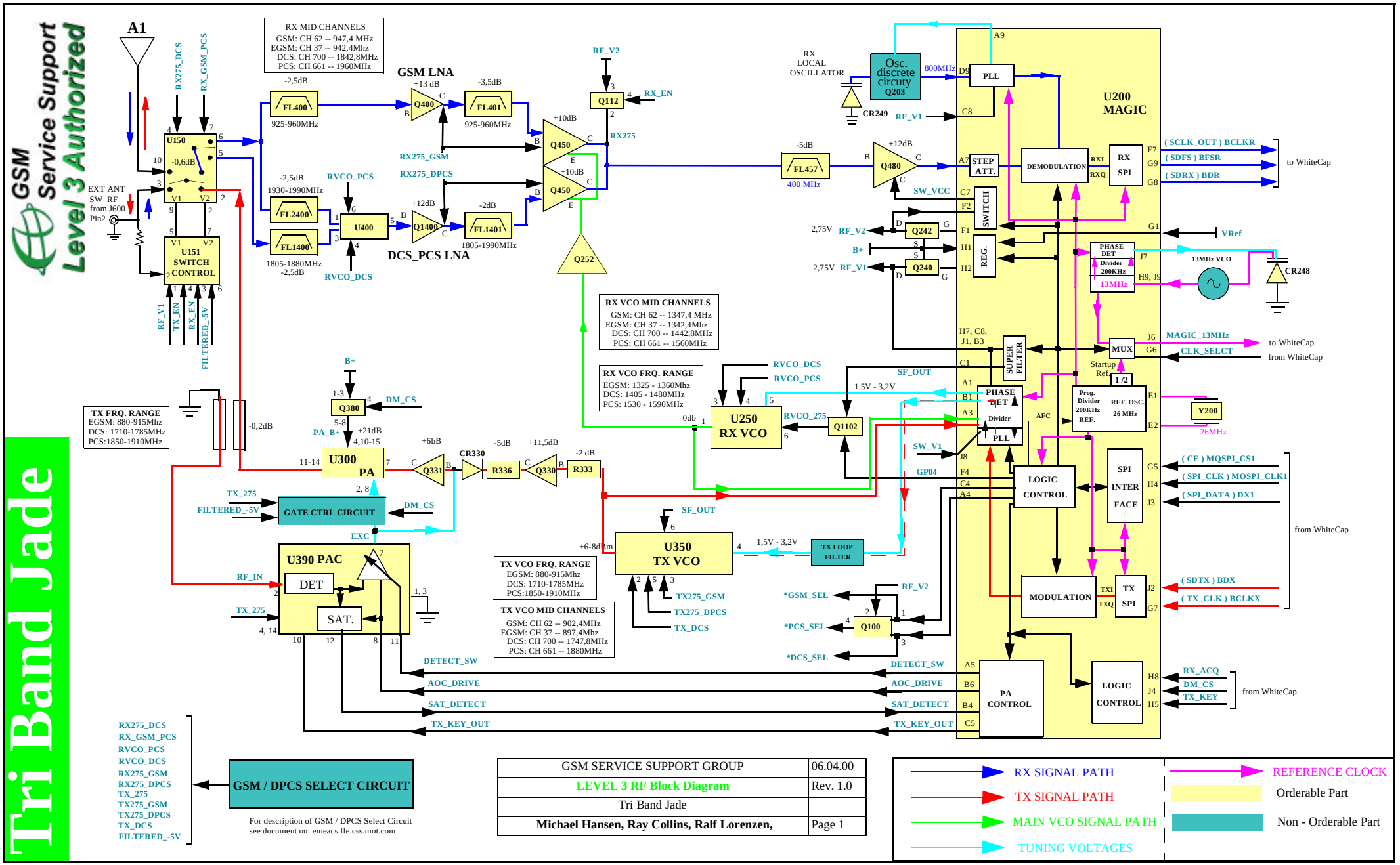
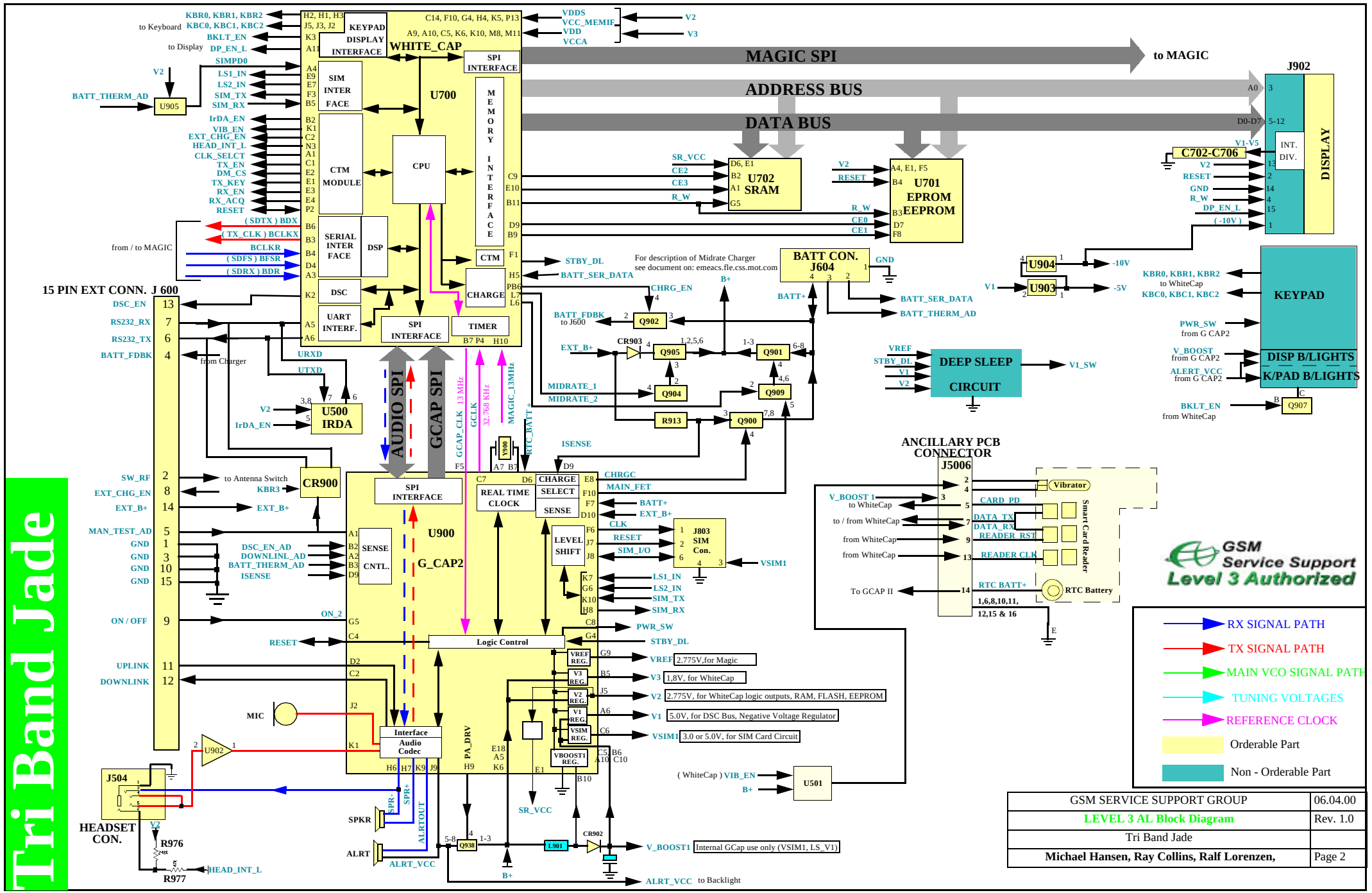
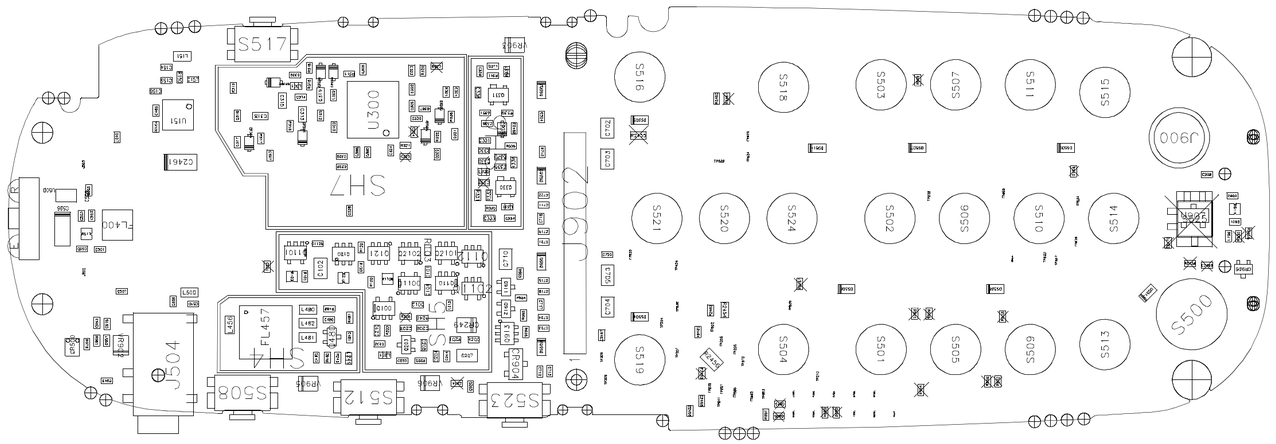
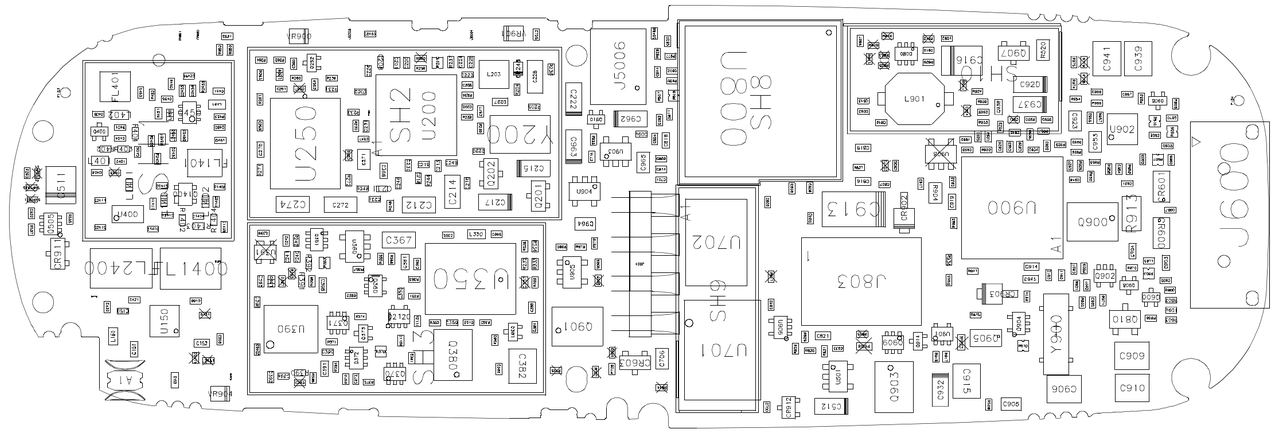

BT2
+
+
−
CR1
CR2
VR1
U1
TP4
TP5
TP6
TP1
TP2
TP3
TOP
PCB P/N: 8486272P05_P5
SMART CARD INTERFACE BD


Tri Band Jade
GSM Service Support Level 3 Authorized
A1
RX MID CHANNELS
GSM: CH 62 -- 947,4 MHz
EGSM: CH 37 -- 942,4Mhz
DCS: CH 700 -- 1842,8MHz
PCS: CH 661 -- 1960MHz
GSM LNA
DCS_PCS LNA
U150
U151 SWITCH CONTROL
EXT ANT
SW_RF
from J600
Pin2
FL400
FL401
FL2400
FL1400
Q400
Q450
Q1400
Q1401
U400
Q112
Q252
RX275_DCS
RX_GSM_PCS
RX275_GSM
RX275_DPCS
RX275
RX_EN
RVCO_PCS
RVCO_DCS
RX VCO MID CHANNELS
GSM: CH 62 -- 1347,4 MHz
EGSM: CH 37 -- 1342,4Mhz
DCS: CH 700 -- 1442,8MHz
PCS: CH 661 -- 1560MHz
RX VCO FRQ. RANGE
EGSM: 1325 - 1360Mhz
DCS: 1405 - 1480MHz
PCS: 1530 - 1590MHz
U250 RX VCO
RVCO_275
Q1102
SF_OUT
1,5V - 3,2V
RX LOCAL OSCILLATOR
Osc. discrete circuty Q203
800MHz
CR249
RF_V1
RF_V2
U200 MAGIC
PLL
STEP ATT.
DEMODULATION
RX SPI
FL457
Q480
SW_VCC
SWITCH
REG.
Q242
Q240
2,75V
B+
PHASE DET
Divider
200KHz
13MHz
13MHz VCO
CR248
VRef
SUPER FILTER
MUX
MAGIC_13MHz
CLK_SELCT
to WhiteCap
from WhiteCap
Startup Ref.
1 /2
Prog. Divider 200KHz REF.
REF. OSC. 26 MHz
Y200
26MHz
AFC
SW_V1
GP04
LOGIC CONTROL
SPI INTER FACE
(SCLK_OUT) BCLKR
(SDFS) BFSR
(SDRX) BDR
(CE) MQSPI_CS1
(SPI_CLK) MOSPI_CLK1
(SPI_DATA) DX1
from WhiteCap
MODULATION
TX SPI
(SDTX) BDX
(TX_CLK) BCLKX
PA CONTROL
LOGIC CONTROL
RX_ACQ
DM_CS
TX_KEY
from WhiteCap
TX FRQ. RANGE
EGSM: 880-915Mhz
DCS: 1710-1785MHz
PCS:1850-1910MHz
U300 PA
Q380
Q331
Q330
R336
R333
CR330
PA_B+
DM_CS
GATE CTRL CIRCUIT
TX_275
FILTERED_-5V
EXC
U390 PAC
DET
SAT.
RF_IN
TX VCO FRQ. RANGE
EGSM: 880-915Mhz
DCS: 1710-1785MHz
PCS:1850-1910MHz
TX VCO MID CHANNELS
GSM: CH 62 -- 902,4MHz
EGSM: CH 37 -- 897,4Mhz
DCS: CH 700 -- 1747,8MHz
PCS: CH 661 -- 1880MHz
U350 TX VCO
TX275_GSM
TX275_DPCS
TX_DCS
TX LOOP FILTER
*GSM_SEL
*PCS_SEL
*DCS_SEL
Q100
DETECT_SW
AOC_DRIVE
SAT_DETECT
TX_KEY_OUT
RX275_DCS
RX_GSM_PCS
RVCO_PCS
RVCO_DCS
RX275_GSM
RX275_DPCS
TX_275
TX275_GSM
TX275_DPCS
TX_DCS
FILTERED_-5V
GSM / DPCS SELECT CIRCUIT
For description of GSM / DPCS Select Circuit see document on: emeacs.fle.css.mot.com
GSM SERVICE SUPPORT GROUP
06.04.00
LEVEL 3 RF Block Diagram
Rev. 1.0
Tri Band Jade
Michael Hansen, Ray Collins, Ralf Lorenzen,
Page 1
RX SIGNAL PATH
TX SIGNAL PATH
MAIN VCO SIGNAL PATH
TUNING VOLTAGES
REFERENCE CLOCK
Orderable Part
Non - Orderable Part


Tri Band Jade
MAGIC SPI
ADDRESS BUS
DATA BUS
to MAGIC
J902
DISPLAY
U700
CPU
CTM MODULE
SIM INTER FACE
SERIAL INTER FACE
DSP
UART INTERF.
DSC
CTM
CHARGE
TIMER
SPI INTERFACE
KEYPAD DISPLAY INTERFACE
MEMORY INTERFACE
WHITE_CAP
U702 SRAM
U701 EPROM EEPROM
15 PIN EXT CONN. J 600
BATT CON. J604
DEEP SLEEP CIRCUIT
U500 IRDA
CR900
U900
G_CAP2
SENSE CNTL.
SPI INTERFACE
REAL TIME CLOCK
CHARGE SELECT SENSE
LEVEL SHIFT
J803 SIM Con.
Logic Control
Interface Audio Codec
PA_DRV
U902
U905
U501
U903
U904
Q902
Q903
Q904
Q905
Q901
Q909
Q900
R913
Q907
Q938
L901
CR902
AUDIO SPI
GCAP SPI
ANCILLARY PCB CONNECTOR
J5006
Vibrator
Smart Card Reader
RTC Battery
J504
HEADSET CON.
R976
R977
KEYPAD
DISP B/LIGHTS
K/PAD B/LIGHTS
C702-C706
INT. DIV.
GSM Service Support Level 3 Authorized
RX SIGNAL PATH
TX SIGNAL PATH
MAIN VCO SIGNAL PATH
TUNING VOLTAGES
REFERENCE CLOCK
Orderable Part
Non - Orderable Part
GSM SERVICE SUPPORT GROUP
06.04.00
LEVEL 3 AL Block Diagram
Rev. 1.0
Tri Band Jade
Michael Hansen, Ray Collins, Ralf Lorenzen,
Page 2

GSM
Service Support
Level 3 Authorized





TRIBAND JADE_84D86261P05

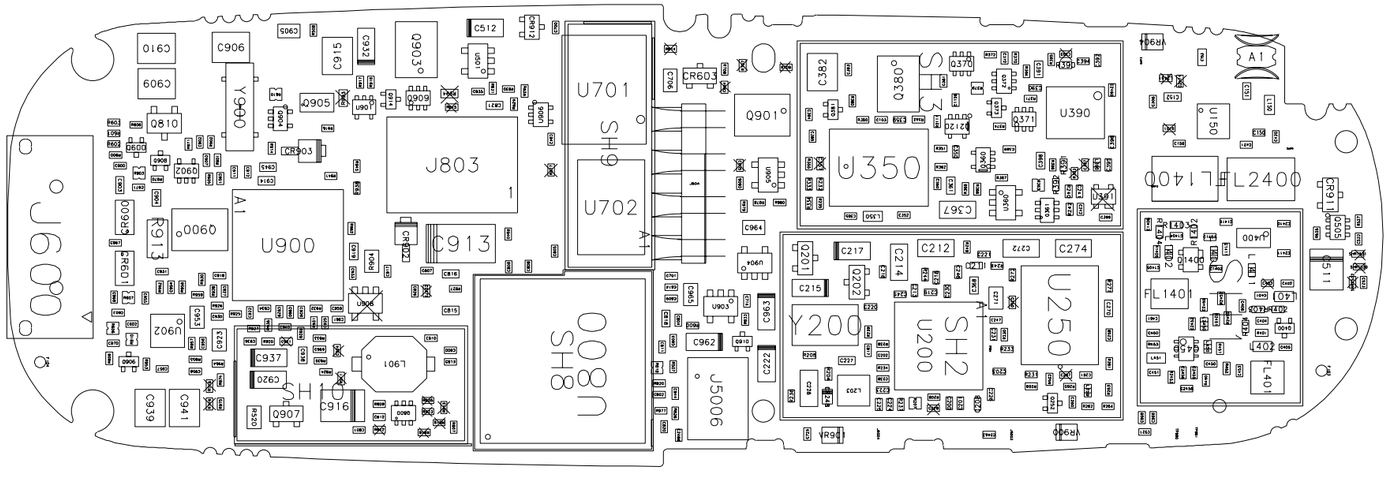
REVISIONS

GSM SERVICE SUPPORT GROUP	27.03.00
LEVEL 3 LAYOUT	Rev. 1.0
TRIBAND JADE	84D86261P05
Michael Hansen, Ralf Lorenzen, Ray Collins	Page 1

P/N:8486261P05_P5

DO NOT PLACE:

R994,R993,SHRT532,SHRT531,SHRT530,R825,R823,R819,R813,R911,R817,
R816,R815,R814,R812,R719,R718,R709,R707,R393,R121,C605,C604,C961,
C924,C921,C403,C397,C393,C357,C250,C257,C229,U391,u908
L2451,C2471,C2472



JADE
P5
11 JAN 2000